

THE MARINE ALGAE OF LORD HOWE ISLAND.

By A. H. S. LUCAS, M.A., B.Sc.

[Read 26th June, 1935.]

This account of the sea-weeds of Lord Howe Island is based on observations and collections made by Mrs. F. Perrin and myself during a stay on the island in the winter of 1933, from 22nd May to 7th July. We were greatly helped by the practical assistance of Mr. Gower Wilson, a leading resident of the island. Mr. Wilson has an intimate knowledge of the shores, reefs and waters, and by aid of his motor launch and rowing boat we were able to make landings on the reef which protects the lagoon, to reach the plants growing in the lagoon itself, and to visit the more distant beaches. He also provided ample space and means for storing and mounting our gatherings.

Further material was available in a large collection made by Mr. J. H. Maiden in 1898, preserved in the Herbarium of the Botanic Gardens, Sydney, and in extensive collections made by Mr. R. Baxter, another resident, which came into my hands by the courtesy of Dr. Charles Anderson, Director of the Australian Museum, and of Dr. Darnell Smith, the late Curator of the Sydney Botanic Gardens. Mr. F. A. McNeill and Mr. A. Livingstone added a few more specimens, which they obtained during their explorations of the marine fauna of the island.

For the large number of specimens gathered and the rapidity and skill with which they were treated I wish to acknowledge my great indebtedness to the whole-hearted and untiring energy of my colleague, Mrs. Perrin.

The Algae of Lord Howe Island.

CHLOROPHYCEAE.

<i>Ulva Lactuca</i> L.	<i>Caulerpa fastigiata</i> Mont.
<i>Enteromorpha Howensis</i> , n. sp.	<i>C. taxifolia</i> (Vahl) Ag.
<i>Chaetomorpha aërea</i> (Dillw.) Kuetz.	<i>C. thujoides</i> J. Ag.
<i>Cladophora Goweri</i> , n. sp.	(<i>C. Brownii</i> Endl.)
<i>Spongocladia vaucheriiformis</i> Aresch.	<i>C. racemosa</i> Forsk.
<i>Dictyosphaeria favulosa</i> (Mert.) Dcne.	<i>C. peltata</i> Lamour.
<i>Cladophoropsis Howensis</i> , n. sp.	<i>Chlorodesmis major</i> Zan.
<i>Valonia Forbesii</i> Harv.	<i>Codium Lucasii</i> Setchell.
<i>V. confervoides</i> Harv.	<i>C. spongiosum</i> Harv.
<i>V. pachynema</i> (Harv.) von Martens.	<i>C. bulbopilum</i> Setch.
<i>Acetabularia calyculus</i> Quoy & Gaimard.	<i>C. indicum</i> Setch.
<i>Bryopsis plumosa</i> (Huds.) Ag.	<i>C. cuneatum</i> Setch. & Gardn.

CHLOROPHYCEAE.

ULVA L.

ULVA LACTUCA L.

Growing in winter (June, July) abundantly on the floor of the lagoon on coral boulders, at the depth of 1 or 2 fathoms. Gower Wilson said that in summer plants of 4 or more inches diameter appear on the rocks bordering the

lagoon, and on the reefs, but we only met with a very few stunted specimens in these situations.

The fronds elongated, up to 30×20 cm., with a limited attachment area, much divided into elongate lobes with undulate margins and broad rounded apices. The colour a bright light-green. The fronds regularly distromatic, the cells elongated at right angles to the surface. Among them, in one of the plants examined, were scattered much larger rounded green bodies, perhaps parasitic.

ENTEROMORPHA Link.

ENTEROMORPHA HOWENSIS, n. sp.

Forming soft vividly light-green mats on rocks covered at high tide at Ned's Beach. The plants are gregarious, growing close together with their bases buried in fine coral sand. Each has an erect stem about 10 mm. in height, tapering upwards from an enlarged base $112-202\mu$ in diameter, and branching from the very base. Branches crowded, emerging on all sides at a wide angle, nearly as long as the central axis but slenderer, $40-90\mu$ diameter, and again bearing similarly numerous, very much shorter and slenderer branchlets. All apices obtuse. The cells very small and compacted, subequal in length and width (3μ), the endochrome filling the greater part of the cell.

Frondes densissime pulvinatae; singulae pusillae, ad 10 mm. altae, erectae, strictae, omnino ramosae, basi incrassatae, $112-202\mu$ diam., superne attenuatae; rami crebri, lato anguli exsurgentes, longi, $40-90\mu$ diam., crebris brevioribus tenuioribus ramellis. Apices obtusi, cellulae compactae parvulae, 3μ diam. Color pallide laetevirens.

CHAETOMORPHA Kuetzing.

CHAETOMORPHA AËREA (Dillw.) Kuetz.

In clumps, much eaten down, on half submerged rocks on Blinkenthorpe Beach and the Old Gulch.

Filaments erect, rigid, light pale-green. Cells as long as, or shorter than, broad; about 585μ , contracted somewhat at the genicula.

CLADOPHORA Kuetz.

CLADOPHORA GOWERI, n. sp. Pl. v, fig. 1; Text-fig. 1.

Radical apparatus a small irregular disc from which rise a number of intricate fronds.

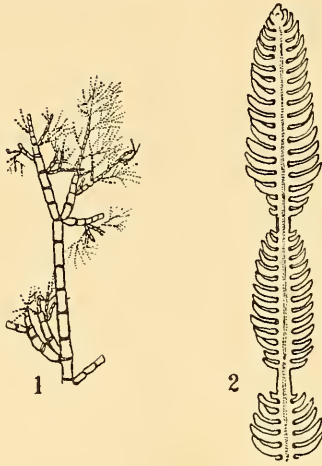
Fronds nitellaeform, 15-20 cm. high, repeatedly di-trichotomous or more often verticillate or fascicled. The branches shorten as they ascend, the ultimate whorls 2 or 3 mm. in length. Terminal segments of the ramelli are commonly and strongly recurved. Apices obtuse. Diameter of main stems $450-600\mu$, of branches diminishing to 150μ , of ultimate segments $20-30\mu$. Integuments and septa, especially of the main stems, lamellose. Articulations of main stems fairly uniform throughout, about 4×1 , of ramuli 2, 3×1 , cylindrical, not constricted at the joints. Colour a bright green (laetevirens).

Isolated plants growing on the floor of the lagoon at a depth of 2-4 fathoms.

Named after Mr. Gower Wilson, who with his boat and rake and intimate acquaintance with the lagoon and the coasts of Lord Howe Island was of the greatest help to us in our investigations.

Frondes intricatae exsurgentes e disco parvulo; singulae nitellaeformes, 15-20 cm. altae, repetite di-trichotomae vel saepius verticillatae aut fasciculatae. Rami superne gradatim breviores, verticilli ultimi 2, 3 mm. longi, saepe fortiter

recurvati. Apices obtusi. Diam. caulis 450–600 μ , ramorum 150 μ , segmentorum terminalium 20–30 μ . Integumenta septaque lamellosa. Articuli caulis circ. 4 \times 1, ramulorum 2, 3 \times 1, cylindrici non geniculis constricti. Color laetevirens.



Text-fig. 1.—*Cladophora Goweri*, n. sp., with epiphyte.
Text-fig. 2.—*Caulerpa taxifolia* (Vahl) Ag.

SPONGOCLADIA Areschoug.

SPONGOCLADIA VAUCHERIFORMIS Aresch.

Growing on coral blocks or fragments, like a sponge, so closely attached to the rugosities of the coral that it cannot be removed without tearing. Compacted below but presently breaking into thick, free, irregularly dichotomous or digitate lobes reaching a height of to 10 cm. Thickness of the lobes to 1 cm. Lobes mostly terete but sometimes compressed. Apices of lobes very blunt, mostly rounded but occasionally somewhat pointed. Lobes often adhering together. Colour a light green.

The whole mass composed of a dense, closely compacted felt of filaments not to be separated and disentangled without tearing. Filaments pseudo-dichotomous at long intervals, with acute sinuses, 80–125 μ in diameter, irregularly articulate, joints from 1 to several mm. long, apices rounded obtuse.

The plant seems to answer to Areschoug's description.

DICTYOSPHAERIA Decaisne.

DICTYOSPHAERIA FAVULOSA (Mert.?) Dcne.

Growing in shallow pools on the reef, closely appressed for the most part to the rock surface. The margins monostromatic but the central attached part thick, in two or more layers. The cells of the mesh 600–800 μ in diameter. Of a rather dark green. Our largest plants were about 2 inches across.

Clearly the tropical form and differing from the *D. sericea* Harv. of our temperate regions in South Australia, Victoria and Tasmania. In all the many specimens I have gathered of *D. sericea* the cells of the mesh were very much smaller, measuring about 200 μ , and only very exceptionally reaching 300 μ . The colour of the growing plants of *D. sericea* is a vivid green.

CLADOPHOROPSIS Børgesen (= *Siphonocladus* Schmitz.).

CLADOPHOROPSIS HOWENSIS, n. sp.

Irregularly ovate cushions to 10 cm. long, 5-8 cm. broad, with the habit of an Aegagropilous *Cladophora*. Soft, dense and spongy. Unicellular, much but rather distantly branched, branches intricate. Segments long intricate, usually straight and free, sometimes two approximating adhere by their adjacent convexities. Altogether and uniformly filiform, fila 150-225 μ in diameter. Apices round obtuse, not clavate. Cell membrane finely striated longitudinally. Endochrome saccate. Colour of the cushions dark green.

Frons pulvinum, ad 10 cm. longum, 5-8 cm. latum, more Cladophorae (Aegagropilae) efficiens, densa, mollis, spongiosa, copiose admodum distanter ramosa. Rami intricati; ramuli plerumque liberi nonnumquam adhaerentes. Omnino filiformis inarticulata; fila uniformiter 150-225 μ diam. Apices rotundato-obtusi, nec clavati. Color obscure virescens.

VALONIA Ginnani.

VALONIA FORBESII HARV.

Growing in small clumps in the pools of the outer reefs. A sessile form, mostly about 2 cm. high, obovate-pyriform.

I have this species from the Low Islands off Port Douglas, from the Michaelmas Cay off Cairns, and from Magnetic Island off Townsville. The northern plants are larger than those from Lord Howe, 2.5 to even 4 cm. long and much more attenuated into a pedicel.

It has a wide range in the tropics from Ceylon, the Friendly Islands, Tahiti to the Loo Choo Group and the Sandwich Islands.

VALONIA PACHYNEMA (Harv.) von Martens.

Loose, not spongy, cushions, 10-16 cm. \times 8-10 cm. and 2-4 cm. thick. Composed of a felt of intricate branches. No articulations. Branches loosely di-trichotomous or repeatedly but irregularly umbellate, axils rather acute. Fila coarse to 0.9 mm. in diameter. The saccate character of *Valonia*. Apices rounded obtuse. Bright green.

v. Martens obtained his plant from Sumatra. It seems to be near to *V. Cladophora* Kuetz. from New Caledonia. I have not seen specimens of either, and offer my determination with hesitation. The Lord Howe plant is a very definite form, but so intricate that it is difficult to dissect it out to discover the method of attachment and the exact ramification. We only found cast up specimens and did not observe it growing.

VALONIA CONFEROIDES HARV.

Widespread caespitose, the lower part of the frond unbranched, the upper part branching, the branches subumbellate. All filaments nearly uniform, about 1 mm. diameter. Apices obtuse.

Collected by R. Baxter in 1922.

Widely distributed in warmer seas of all the oceans.

Recorded from Stone Island and the Bloomfield R., N. Queensland.

ACETABULARIA (Tourn.) Lamouroux.

ACETABULARIA CALYCVLUS Quoy & Gaimard.

A single plant was found, growing on a coral block dragged up from the floor of the lagoon in shallow water.

The Australian plant was obtained by Freycinet in Western Australia. Clifton dredged it at Fremantle. I have it from Dongarra, and from Cottesloe, found by Miss Iris Banks growing on submerged rocks in the estuary of the Swan River. On the East Coast I have gathered it growing luxuriantly on dead oyster shells in Lake Macquarie, and scattered specimens at Sandgate, near Brisbane. I have specimens collected by Harvey at Newcastle, as well as others he had collected in Tonga. Dickie recorded it from Mauritius. It is thus evidently a plant of wide distribution on moderately warm shores, and is not recorded by Laing from New Zealand.

Kilner discovered a much larger form, *A. Kilneri* J. Ag., in tropical Australia at Edgcombe Bay.

BRYOPSIS Lamour.

BRYOPSIS PLUMOSA (Huds.) Ag.

Reinhold determined the Norfolk Island *Bryopsis* as *B. foliosa* Sond. Our specimen showed regularly distichous, not secund, ramenta.

CAULERPA Lamouroux.

CAULERPA FASTIGIATA Mont.

Collected by R. Baxter, 1922. Figured Proc. Linn. Soc. N.S.W., Vol. 52, Part 4, 1927, Pl. 43.

The West Indies, Brazil, the Friendly Islands.

CAULERPA TAXIFOLIA (Vahl) Ag. Text-fig. 2.

Growing freely in mats over the sides of rock-pools exposed to the rough action of the waves and billows on the reef at Blinkenthorpe Beach.

Surculus very slender, to 1 mm., but usually less, in diameter, ramifying, with slender radicles, freely intertwining so that plants form close masses, glabrous. Assimilators erect, mostly simple but occasionally giving off a branch, linear, to 10.5 cm. long, bearing to 90 pairs of ramenta almost from the base. Ramenta sessile, distichous in opposite pairs, patent, falcate-incurved, flat, rather acute to mucronate, to 4 mm. long and as wide as the axis, about 0.85 mm. Those near base and apex shorter. Dark green in colour.

Rarely some of the assimilators among the normal ones show an interrupted growth as occurs in *C. scalpelliformis*. I saw no tristichous fronds.

Particularly luxuriant examples of the species.

Dr. Nils Svedelius, to whom I sent samples of our Lord Howe Caulerpas, remarks: "A big form of this species, otherwise as far as I can see typical."

From the Friendly Islands (Harvey) and N.E. Australia (Kilner). Dr. F. Börgesen found it in the North Arabian Sea at Karachi and Okha Port, and gives a wide distribution of the plant from the West Indies, Red Sea, Ceylon, Malay Archipelago and Japan (Algae from Arabian Sea, 1934).

CAULERPA THUJOIDES J. Ag. Pl. v, fig. 2.

Creeping on the rough floor of the lagoon at depths less than a fathom or in pools on the coral reef. Common.

Surculus stout, to 2 mm. diam., branching, glabrous, terete or angular, with longitudinal ridges and furrows, sending up widely distant, 2-4 cm. apart, vertical assimilators, and sending down at similar wide intervals radicles with much divided fibrils. Assimilators erect, robust, 3-5 times dichotomous, subfastigate, naked and rugulose below to a height of 1.5 cm., and attaining a length of to

9 cm., bearing ramenta arranged in regular longitudinal, mostly 4, series. Ramenta very dense, imbricate, broadly ovate, apiculate or the apex drawn out into rather long mucro, a little longer than the width of the rachis, deep green.

The N.E. shores of Australia (Kilner).

The determination has been confirmed for me by Dr. Svedelius and Professor Kylin, the latter after comparison with the originals in J. G. Agardh's herbarium in Lund. The Australian species stands on its own merits, and it seems unwise to place it as a form of the West Indian *C. cupressoides* (Vahl) Ag.

CAULERPA BROWNII Endl.

"*C. Brownii* Endl. v. *minor* J. Ag. (Weber v. Bosse, Monogr. des Caulerpes, p. 306), but not *delicatula*."

Dr. Svedelius has given me this determination. This was an agreeable surprise to me, for I had not known that we had found this species at Lord Howe. We did not observe it growing or cast up. It looks as if I had inadvertently sent to Europe the only specimen or specimens occurring on the island. It is one of our most familiar and common species in Australia and Tasmania, as well as New Zealand.

CAULERPA RACEMOSA Forskaal.

The most abundant *Caulerpa*, growing especially on the slopes of the reefs in shallow water below low tide level, but also on the floor of the lagoon at no great depth. It grew luxuriantly in vividly green masses of clusters resembling currants or small grapes and often covering several square feet of area. The surculi robust, to 2 feet long and 3 mm. diam., branching distantly and attached to the rough coral surface by numerous stout radicles. The assimilators rising at intervals of 0.5 to 2 cm., attaining in some cases lengths of 10-12 cm., and bearing the ramenta on all sides so close together that they quite conceal the axis. Utricles spherical, to 3 mm. diam., supported on thick peduncles rather less than half as long as the complete ramentum.

Quite edible, of a rather pleasant taste.

Dr. Svedelius writes me: "*C. racemosa* with the exceptionally long assimilators is coarser than any *racemosa*-forma I have seen in Ceylon. However, it resembles the *C. racemosa* v. *occidentalis* Börg. from the West Indies, described and figured by Dr. Börgesen in his *The Marine Algae of Danish West Indies*, Vol. I, p. 152 (*Dansk. Bot. Archiv.*, Bd. I, 4, Copenhagen, 1913-14). It is a big form more than 10 cm. high. Specimens from Bermuda could reach 1 foot! This find is very interesting, as it is a new example of Algae common for the West Indies and the Pacific."

CAULERPA PELTATA Lamour.

Creeping among other algae on reefs, in pools just below low tide level.

Very slender and inconspicuous, but with the peltae so directed as to catch the light. When disentangled from the other weeds the appearance of the fronds was very much that shown in the excellent figure (Fig. 31) given by Svedelius in his "Ecological and Systematic Studies of the Ceylon Species of *Caulerpa*". The discs varied in diameter, the most mature reaching 3 mm. None were seen of the forms figured by Svedelius in Figure 32 "*ad nummulariam*" or in Figures 33, 34 "*ad claviferam*".

Not heretofore recorded from Australian seas. Previous localities: Red Sea, Mascarene Is., Ceylon and Java Sea.

CHLORODESMIS Bail. & Harv.

CHLORODESMIS MAJOR Zan.

Spreading in rounded mats of surpassing beauty on the bottom or over the sides of reef pools or on the adjacent floor of the sea; at low tide even exposed to the atmosphere but usually only accessible by wading. Attached by a reddish-orange felt of threads distributed in loose coral sand, the plant grows out on all sides in a mop of long sparingly branching filaments of a deep dark green colour, which float freely in the water. These filaments, like fine green hairs, reached, in the plants we gathered, a length of 5 or 6 inches, but we were assured by residents of the island that in the summer plants were often thrown up with threads as much as four feet long.

Zanardini had some hesitation in separating the Lord Howe Island form from the *Chlorodesmis comosa* Bail. & Harv. which occurs on the Barrier Reef and South Pacific Islands. I think, however, that he was justified. Not only are the filaments of the Lord Howe plant vastly longer, they are also nearly twice as stout, about 185μ in diameter, whilst those of plants of *C. comosa* we gathered on the Low Islands and the plant I have of Harvey's Friendly Island Algae have the diameter $92-108\mu$ and 92μ respectively. Again, the constrictions in the upper branches of *C. major* lie nearly at the same level, while in the smaller species there is a marked difference in level. The long isolation of Lord Howe has given time for the evolution of a form which seems to me to be worthy of specific distinction.

CODIUM Stackhouse.

I forwarded specimens of the Lord Howe Codiums to Professor W. A. Setchell of the California University, who has for some years been devoting much attention to the genus. He has proposed a new arrangement of the species. This I have followed, and also availed myself of the full notes and descriptions which he has most kindly furnished for my use. He divides the genus into two subgenera, (1) *Tulecodium* (? *Tylecodium*), comprising the unbranched forms, and (2) *Schizocodium*, comprising the dichotomously branched forms.

Tulecodium Setchell, subgenus novum.

Thallus applanatus, pulvinatus, aut usque ad globosus, basi latiori angustiorive adhaerens, neque cylindricus, neque vere ramosus; utriculis ramosis, rare simplicibus (Codi sectiones *Adhaerentia* et *Bursae* Auctt. complectens).

ADHAERENTIA De Toni (lim. mut. et restr.).

Codii thallis applanatis, marginibus leviter usque ad profunde lobatis; utriculis mesophysis, steno- usque ad hyp-euryphysis, obtusis.

CODIUM LUCASII Setchell, n. sp. Text-fig. 3 (6-12).

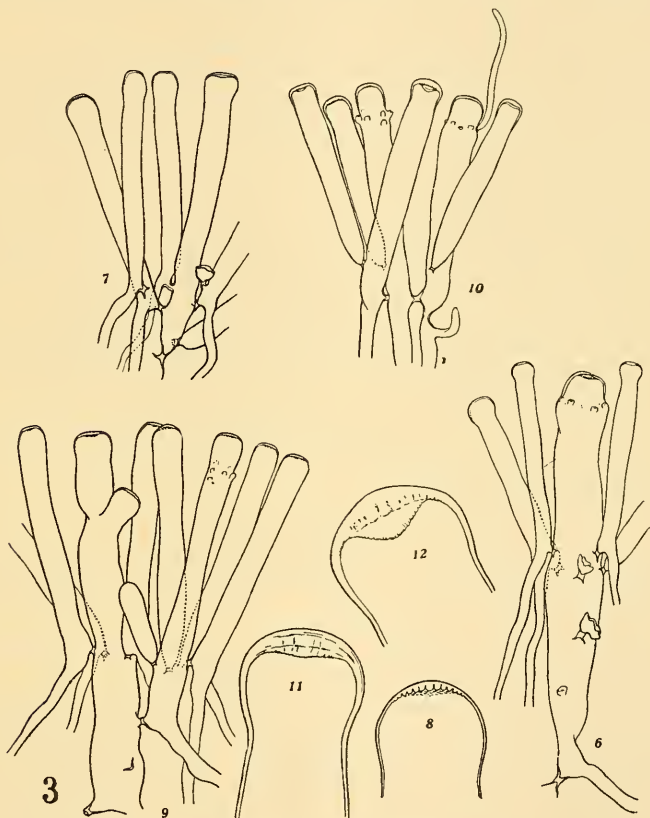
C. thallo primo pulvinato orbicularique, mox lobato, lobis latiusculis aut angustioribus laxe cohaerentibus, crassiusculis et atroviridibus, ad substrata laxiuscule adhaerentibus; utriculis mesophysis, libere ramosis, individuis elongatis ($435-600\mu$ longis), modice ($50-250\mu$) latis, cylindricis, apice depresso globuloso inflatis, pills in circulo irregulari infra capitula inflata insertis, membranis apicalibus tenuibus usque ad 10μ incrassatis, intus leviter usque ad conspicue alveolatis; gametangiis nondum visis.

Type specimen, herb. Univ. Calif., No. 395199, Bondi, N.S.W., Australia, legit A. H. S. Lucas; *Codium adhaerens* Harvey (non C. Ag.), Australian Algae, No. 576,

from Newcastle, N.S.W. (fide spec. in herb. Kew); additional occurrences, Maroubra Bay, N.S.W., A. H. S. Lucas, Oct., 1931; Long Reef, Collaroy (near Sydney), N.S.W., A. H. S. Lucas, Nov., 1930; Lord Howe Island, F. Perrin and A. H. S. Lucas, June, 1933; Point Lonsdale (Port Phillip Hds.) and Flinders (Western Port), A. H. S. Lucas.

I have not observed it in Tasmania.

Both in habit and utricles, the specimens referred to this species are sufficiently distinct from typical specimens of *Codium adhaerens* C. Ag., from the western coasts of Europe. It seems closely related to *C. intertextum* Collins and Hervey, from Bermuda and the West Indies. The lobing is coarser in the Australian plant and the lobes do not seem to "climb" over one another. The utricles differ somewhat in shape and size and lack the several successive circles of hairs characteristic of *C. intertextum*. The extreme geographic discontinuity also



Text-fig. 3.—*Codium Lucasii* Setchell.

6, 7. Utricle groups from specimen collected at Bondi, N.S.W., by A. H. S. Lucas, Aug., 1901. $\times 70$.—8. Tip of utricle from same specimen. $\times 280$.—9. Utricle group from specimen collected at Collaroy, N.S.W., by A. H. S. Lucas. $\times 70$.—10. Utricle group from specimen distributed as *C. adhaerens* (non C. Ag.) from Newcastle, N.S.W., by Harvey as 576 of his Australian Algae (in herb. Kew). $\times 70$.—11, 12. Tips of utricles from preceding. $\times 280$.

argues for separation. Possibly the gametangia, when observed, may assist in distinguishing the two species.

Plant prostrate, cushion-shaped, orbicular at first, soon giving off broader or narrower lobes which form a close, flat pattern, fairly loosely adherent to the substratum, of soft, spongy consistency, dark green; utricles mesophyse (or of moderate size), freely branched towards the base, the individual utricles elongated (435–600 μ long), moderately broad (50–250 μ wide), cylindrical, with depressed globose tips, and below this an irregular circle of hairs, apical membrane thin or up to 10 μ thick, slightly or decidedly alveolate within; gametangia have not yet been observed.

The above descriptions are Professor Setchell's. He founded the species on material I sent him on previous occasions from the south-east coasts of Australia. He also examined a type specimen collected by Harvey, Alg. Exs. No. 576, and preserved in Herb. Kew. Harvey identified it with *C. adhaerens* (Cabr.) Ag., but the differences are marked, as pointed out by Setchell.

Since receiving his description I have been fortunate in finding gametangia. Harvey does not seem (*Phyc. Brit.*) to have observed them in his British specimens, but O. C. Schmidt describes and figures the gametangia of *C. adhaerens* in his Monograph of the genus. Those of *C. Lucasii* are stout and ovate instead of cylindrical or spindle-shaped; of dimensions 230–277 μ \times 108–123 μ , in contrast to 275–350 μ \times 60–75 μ of *C. adhaerens*.

It always appears in the same habitat at low tide level, extending over ledges or on faces of rock, adapting itself closely to the inequalities of the rock surfaces; of variable outline, often ribbon-like but with rounded edges and lobes. The area covered may reach to a very few square inches, but I have never seen "patches of one, two or more feet in diameter" such as Harvey records of *C. adhaerens* in his *Phycologia Britannica*. The substance is tough and leathery, the surface smooth and slippery, and the colour a dark, almost black, green.

SPONGIOSA Setchell, sectio nova.

Codii thallis pulvinatis, convolutis usque ad globoso-lobatis, utriculis mega-, usque ad megistophysis, apice obtusis.

CODIUM SPONGIOSUM HARV.

Growing in great abundance in nooks and recesses of the rocks of the lagoon near low-tide level. Large plants 4–6 inches across and 2 or 3 inches deep were cast up in numbers by the storms.

Typical utricles, 1,500 μ \times 160–280 μ , with membranes scarcely thickened at the apex, and bearing, some single, others 2 or 3 gametangia.

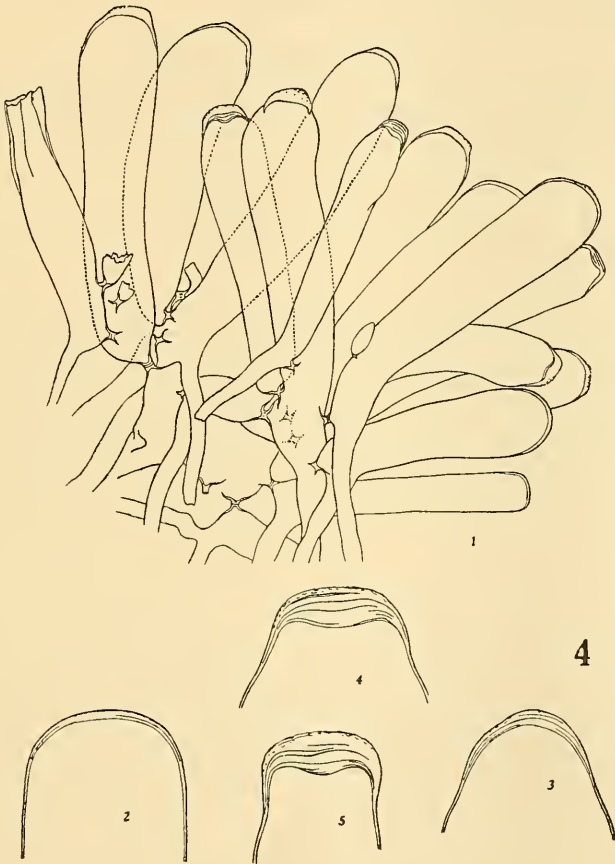
O. C. Schmidt gives the distribution as West, South-west and East Australia, and New Caledonia. He adds a mysterious "Kap" which may mean Cape York; the specimen was given no further indication in the Hamburg Herbarium. Harvey describes it as "Most abundant in King Georges Sound; and it occurs at Geraldton". I have a specimen from Denial Bay in the Great Bight (Dr. Chambers) and a specimen gathered near Adelaide in St. Vincent's Gulf (Dr. J. B. Cleland); have not as yet met it in Victoria; in April, 1934, Mrs. Perrin and I found abundant but not very large plants at Currie's River on the North Coast of Tasmania. It grows near Sydney, in Middle Harbour and Botany Bay, and I have it from near Brisbane. Further north it grows freely on Green Island near Cairns, and the Low Islands near Port Douglas. Lastly, it is

abundant at Lord Howe Island. Laing does not record it from New Zealand. It clearly prefers warm conditions.

I take the opportunity of recording and describing what seems to be a new species of the same section, though it hails from the Tamar Heads, Tasmania, and was not seen at Lord Howe.

Codium Perrinae, n. sp. Text-fig. 4.

C. thallo pulvinato, glauco-viridi, primo (juvene) orbiculari, ultime (aetate provecta) lunulae crescentis formam evolvante; utriculis megistophysis (usque ad $1,250\mu$ longis et ad 375μ latis), pauce aut moderate basi ramosis, oblongo ovoideis, apice applanato rotundatis usque ad truncato galeatis, pilis nullis ornatis, membrana apicali primo tenui, aetate provecta incrassata (usque ad 32μ crassa), subgaleata, striata, externe irregulariter crenulata aut leviter foveolata; gametangiis incertis, nullis maturis adhuc visis.



Text-fig. 4.—*Codium Perrinae* Lucas.
 All figures from specimen collected at Low Head, Bass Strait, Tasmania,
 by P. Ferrin and A. H. S. Lucas, Jan., 1930.
 1. Partial utricule group. $\times 35$.—2-5. Tips of utricles. $\times 70$.

Specimen typicum in herb. A. H. S. Lucas, cotypicum in herb. Univ. Calif., No. 403785, conservata.

Low Head, Bass Strait, Tasmania, leg. F. Perrin et A. H. S. Lucas, Jan., 1930.

This proposed new species approaches *Codium spongiosum* Harv. very closely in texture and utricular structure. It differs especially in its strong tendency to assume a definitely crescentic habit, the lack (or extreme scarcity?) of utricular hairs, and its subgaleate, somewhat foveolate apical membrane.

Plant usually cushion-shaped, orbicular in outline when young, but soon pushing out a pair of lobes at opposite sides which by their curving growth produce a crescent-shaped or even ring-shaped thallus; utricles of the largest size, up to $1,250\mu$ long and 375μ broad, slightly to decidedly branched toward their bases, oblong-cylindrical or ovoid, somewhat flattened at the apex and rotund to truncate galeate by the thickened tip, up to 32μ thick, which is clearly stratified within and slightly crenulate or foveolate externally; no hairs have been observed on the utricles nor any gametangia.

SCHIZOCODIUM Setchell, n. subgenus.

Thallus erectus aut procumbens usque ad repens radicansque, cylindricus aut compressus, usque ad complanatus, rare simplex, vulgo ramosus, aut arcte dichotomus aut subdichotomus; utriculis simplicibus (sectiones aut subsectiones "Tomentosa", "Elongata", "Fragilia" et "Lata" Auctt., complect).

REPENTIA Setchell, sectio nova.

Thallus plus minusve compressus, decumbens, radicans, intertextusque; utriculis mesophysis, obtusis.

CODIUM BULBOPILUM Setchell. Pl. v, fig. 3.

Fronds decumbent, attached to the substratum or to one another at intervals through groups of rhizoidal filaments, from slightly to clearly compressed, somewhat irregularly dichotomous, 1-5 mm. diameter, dark green, soft spongy in texture; utricles more broadly or more narrowly obovoid, usually decidedly enlarged above, commonly about $250-300\mu$ up to 400μ in diameter and $500-600\mu$ in length; hairs single or few in circle surrounding the apex, usually sharply constricted at the base, membrane thin (1μ thick) even at the apex, little thickened (up to 6μ) even in oldest utricles; gametangia elongated oblong ellipsoidal, about $200-250\mu$ long by $62-5\mu$ broad, inserted near the middle of the utricle.

The type of *Codium bulbopilum* Setchell is a young plant from Tutuila, in American Samoa. Better plants were found in Tahiti. Harvey's No. 84, from Lifuka, in the Tonga Islands, distributed under the name of *C. tomentosum*, seems, so far as the specimen in herb. Sydney Bot. Gardens is concerned, to be of this species. It is widespread in the warmer waters of the eastern portion of the Pacific Ocean and is closely related—perhaps even too closely to be separated—to *C. Geppii* O. C. Schmidt of the Malayan Archipelago. It is also similarly related to *C. taitense* Setchell and possibly, when broader experience is available, it may be desirable to group all three species under *C. Geppii*.

I strongly incline to the view that the Lord Howe plants with low-lying and loosely-interwoven segments may be fairly assigned to *C. Geppii*. The utricles I measured were $400-460\mu \times 123-215\mu$ in dimensions, which fall within Schmidt's limits. I could not find gametangia, but Schmidt states that those of *C. Geppii* also are unknown.

Growing in sheltered nooks or depressions on coral rocks in masses of 6-8 inches long, 4-6 inches wide and 2-4 inches high, composed of a tangle of crossing and adhering segments attached to rock by numerous tufts of rhizoids. Branches uniformly cylindrical, tough, 2 mm. diam. Dark green.

CODIUM INDICUM Setchell MS.

Two forms of digitate Codiums occur fairly abundantly on the rocks of the lagoon.

1.—A smaller form to 7 cm. high, frond erect, compacted, with slightly flattened 5, 6 dichotomous divisions.

2.—A larger form to 15 cm. high, frond erect, spreading, with evidently flattened (5-10 mm. wide) segments with 6, 7 dichotomies.

I had considered them to be among the many forms of *C. Muelleri* Kuetz., but Professor Setchell separates them, regarding them as examples of a new species, *C. indicum* Setchell, which he has obtained in other quarters.

The *C. tomentosum* var. *australasicum* Aresch., thence *C. Muelleri* Kuetz., appears in so many varieties around the southern (at least) half of the continent, as well as in Tasmania and New Zealand, that it is clear that a comprehensive revision of the whole is required. I have for long been accumulating material, but am quite unable to deal with it at present.

CUNEATA Setchell, sectio nova.

Codia thallis in toto complanatis, erectis, multoties dichotomantibus; utriculis megaphysis (in specie typica megistophysis sparse intermixtis), obtusis.

CODIUM CUNEATUM Setchell and Gardner. Pl. vi, fig. 1; Text-fig. 5.

Proc. Calif. Acad. Sci., 4 ser., vol. 12, p. 708, pl. 16, figs. 34, 35, pl. 34, May, 1924.

Thallus decidedly flabellate, attached by a relatively small spongy disc, 12-16 cm. high, branching very close to the base, regularly dichotomous, distinctly flattened, especially immediately below the forking, angles rounded; segments between the forkings broadly cuneate, up to 2 cm. wide below the forking, terminal branches numerous, much reduced; utricles 0.5-1 mm. long, 200-250 μ diam., large type up to 450 μ diam. at the outer end; side wall 2-3 μ thick, end wall 8-12 μ thick; hairs short, attached near the outer end of the utricles; sporangia sub-fusiform, widest below the centre, 200-260 μ long, 90-110 μ wide; often extending beyond the utricle.

Codium cuneatum was described from a very regular and symmetrical specimen from the Gulf of California. When well developed there are 8-10 dichotomies and each segment is broadly cuneate.

Later specimens have been seen from British India (Kurrachee and Madras, in herb. Kew), from the southern tip of British India (M. O. P. Iyengar), from the Island of Bali (in herb. Univ. Calif.), from the eastern coasts of Australia (Botany Bay, May, 1930, and Dec., 1930, A. H. S. Lucas; Mosman's Bay, Sydney Harbour, W. A. Setchell, April, 1904); a very depauperate specimen from Low Island, North Queensland, Australia (F. Perrin and A. H. S. Lucas, May, 1931); Bowen, Queensland, Australia (E. H. Rainford, Nov., 1929). The several different areas constituted seemed each to have its own species, and tentative herbarium names were given to them. The differences of habit, however, were not constant, and where a number of specimens were collected in the same locality the variation within the local area, as well as the final disappearance of any definite discontinuity of distribution, has led toward considering all these forms to be simply reasonable variations of one widely distributed species.

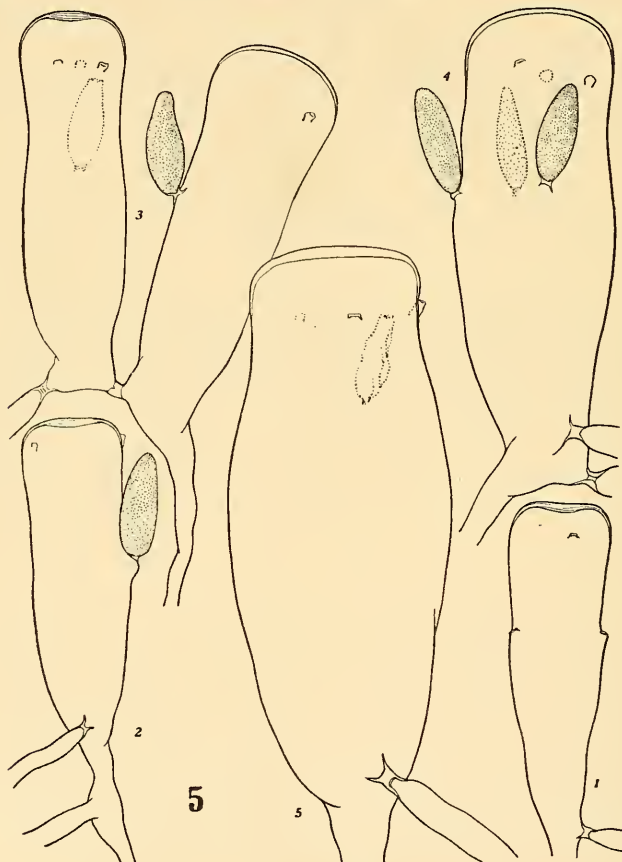
The above is the description by Setchell and Gardner, together with further comments by Professor Setchell. I add some details of the Lord Howe plants.

About a foot high, growing in deeper water probably, attachment not seen. Remnant of stipes nearly 2 cm. long, compressed. Frond flat throughout with few long broad divisions irregularly and sparingly, up to 4 or 5 times dichotomous, under the main forks up to 2.5 cm. wide. Axils rounded, almost semicircular. Apices very obtuse, rounded.

Utricles 1 or 2 mm. long, 120–210 μ broad, with flatly rounded-off tips. Walls of utricle 1.5 μ , of tip 3.5 μ . The utricles remarkable for a system of thin branched colourless trabeculae.

Gametangia about 200 μ long, 70–80 μ broad, situated about a quarter of the length of the utricle below the apex.

By far the flattest form of branched Codiums I have seen in Australia. It looks almost like a branched *C. laminarioides* Harv.



Text-fig. 5.—*Codium cuneatum* Setchell and Gardner.

All figures from specimen collected on Cremorne Point, Sydney Harbour, N.S.W., by W. A. Setchell, 2nd April, 1904.

1-4. Utricles to show variation from shorter to longer, and in both sterile and fertile condition. $\times 70$.

It is noteworthy that of the 24 green Algae observed, 18 (including *Cladophoropsis* and *Valonia*) belong to the unicellular Siphoneae. These, with the exception of *Acetabularia calyculus* and *Bryopsis plumosa*, present a tropical or subtropical facies, and most of them have a corresponding distribution elsewhere. Not one of the Caulerpas (except the doubtful resident, *C. Brownii*) occurs in extra-tropical Australia. Of the Codiums, *C. Lucasii*, *C. spongiosum* and *C. cuneatum* penetrate into more temperate locations, but are also subtropical, while *C. bulbopilum* and *C. indicum* are definitely warm sea forms.

Of the non-Siphoneae, *Dictyosphaeria favulosa* and *Siphonocladia vaucherii-formis* are tropical, *Ulva Lactuca* and *Chaetomorpha aerea* are cosmopolitan, while *Enteromorpha Howensis* and *Cladophora Goweri* are described as new forms peculiar to Lord Howe.

A quite remarkable feature is the apparently total absence of *Halimeda*.

PHAEOPHYCEAE.

<i>Sargassum Howeanum</i> , n. sp. } Phyllotricha	<i>Dictyota prolificans</i> A. & E. S. Gepp
<i>S. sp.</i> }	<i>D. sandvicensis</i> Sond.
<i>S. spinifex</i> Ag. } Eu-Sargassum	<i>D. rugulosa</i> , n. sp.
<i>S. leptopodium</i> J. Ag. }	<i>D. furcellata</i> Ag.
Two undetermined sp. }	<i>Glossophora Harveyi</i> J. Ag.
<i>Cystophyllum muricatum</i> (Turn.) J. Ag.	<i>Ecklonia radiata</i> (Turn.) J. Ag.
f. <i>uninodis</i> , n.f.	<i>Macrocystis pyrifer</i> a (Turn.) Ag.
<i>Hormosira Banksii</i> (Turn.) Dene.	<i>Colpomenia sinuosa</i> (Roth.) Derb. & Soland.
<i>Gymnosorus nigrescens</i> (Sond.) J. Ag.	<i>Hydroclathrus cancellatus</i> Bory
<i>Padina Pavonia</i> (L.) Lamour.	<i>Ectocarpus simpliciusculus</i> Ag. ?
<i>Haliseris crassinervia</i> Zan.	<i>E. confervoides</i> (Roth.) Le Jolis
<i>H. plagiogramma</i> Mont., var. <i>Howensis</i> , n. var.	

SARGASSUM Ag.

SARGASSUM HOWEANUM, n. sp. Pl. vi, fig. 2.

Mingled with other Sargassa or in individual colonies, it forms the greater part of the vegetation of the lagoon floor, the sombre masses furnishing a striking contrast to the occasional green or red algae.

The attachment is discoid, a short swollen stock giving rise to three or more main branches or stems of a length of a foot, more or less, but never tall.

Stems naked and rugged to a height of an inch or so, then angular, clad with crowded pinnate rami spreading in all directions with slender rachides and a height of 6-10 cm., not refracted, bearing ramuli on all sides.

Ramuli decomposit dichotomous to 5 cm. long, with filiform segments diverging at broad angles and bearing vesicles and at length receptacles.

Vesicles borne, especially on the lower divisions of the dichotomy, on slender petioles longer than themselves, quite spherical and from the juvenile stage onwards absolutely mucous, to 4 mm. diam., and dark brown in colour.

Receptacles clustered, fusiform, much shorter than the leaf segments, 2-3 mm. long, stipitate, smooth, simple, forked or even branched. Colour dark fuscous-brown, becoming quite black on drying.

Stipes communis tumida disco affixus. Hinc exsurgunt 3 vel pluris stipites ad 30 cm., ascendentes stipites secundarii, ad 2.5 cm. nudi, non refracti, 6-10 cm. longi, crebris ramulis quoquoversum divergentibus.

Ramuli decomposito-dichotomi ad 5 cm. longi, segmentis filiformibus latis angulis patentibus, vesiculos et demum receptacula ferentes.

Vesiculi in longo petiolo sphaerici, omnes mutici, ad 4 mm. diam.

Receptacula fasciculata fusiformia, multo breviora quam folii segmenta, stipitata, simplicia furcata vel etiam ramosa.

Color obscure fusco-brunneus, in sicco nigrescens.

The plant must be included in Agardh's Section *Phyllotricha* and be placed near to *S. Sonderi* J. Ag. At first sight it might be attributed to that species, but seems to be distinct by possessing larger dark muticous receptacles, by its much darker colour, and by the absence of flattened stems bearing broad pinnatifid leaves. Though many growing plants were observed, no sign of such flattened stems and well developed leaves was seen. So far only known from Lord Howe.

S. Sonderi has a wide range from Western Australia and the South Australian and Victorian coasts to Tasmania. It has not been seen on the coasts of New South Wales and Queensland, nor has it been found in New Zealand.

SARGASSUM SPINIFEX Ag.

The more expanded form, up to a length of a foot, grew in fair quantity on the floor of the lagoon.

S. spinifex has a wide distribution, from Ceylon and China and the warmer waters of Australia. It was sent me from Bowen and Townsville on the coast of Queensland, and it has extended to Dirk Hartog Island on the west and to Lord Howe and Norfolk Islands on the east.

SARGASSUM LEPTOPODUM J. Ag.

Growing with *Haliseris* and other Sargassa on the floor of the lagoon.

Recorded doubtfully from Norfolk Island by Reinbold (*Nuova Notarisia*, 1900).

At least three other species of *Sargassum* were collected; one to be ascribed to Agardh's *Phyllotricha Pteromorphae*, of which only one sterile plant was seen, but which is almost certainly an undescribed species; and the others to be attributed to *Eu-Sargassum Malacocarpicae Racemosae*, but which, with my present knowledge, I do not venture to identify more closely.

It is to be noted that no species of *Phyllotricha Phylloporphae*, and no species of *Arthrophyucus*, was seen.

The absence of the genera *Cystophora* and *Phyllospora* is noteworthy. They occur abundantly on the rocks on the Sydney shores.

CYSTOPHYLLUM J. Ag.

CYSTOPHYLLUM MURICATUM (Turn.) J. Ag. forma UNINODIS, nova.

A number of rachides spring from a flat, rugged attachment to an inch in diameter. Rachides of two kinds; few shorter to 3 inches, simple, bearing leaves only; more elongated to a foot or more, much branched, bearing here and there a solitary reduced leaf, but mostly much branched ramuli, the lower carrying vesicles and the upper receptacles. Rachides rough with almost stalked glands. Leaves narrow linear, those of the leaf-bearing rachides to 2 cm. long, entire and glandulose. Vesicles stalked, ovate, 1.5 mm. long, usually solitary, glandular, crowned with a linear appendage to 7 mm. long.

Receptacles in terminal racemes 15–20 mm. long, 10 or more in a raceme, the older ones to 7 mm. long, mostly simple, linear, verrucose, rarely branched, sometimes carrying a vesicle laterally. Scaphidia crowded, one to each tubercle

excavated below the surface, with one oospore surrounded by mucilage in each scaphidium. I did not see antheridia.

Collected by R. Baxter in 1929; a fine example.

I have a very similar form from Darwin, but the lower parts and leaf-shoots are lacking, so that I cannot assert identity.

The form agrees with *C. muricatum* in general habit, the rough glandulose rachides, the entire basal leaves and the linear racemose receptacles. It differs in being slenderer, and in its crowded branchlets and vesicles, the latter almost invariably solitary and never in strings of three; in fact the plant might well be taken at first sight for a plant of *Sargassum Sonderi* J. Ag.

C. muricatum occurs, often plentifully, in sheltered harbours all round the Australian coasts.

HORMOSIRA Endl.

HORMOSIRA BANKSII (Turn.) Decne.

We saw, and only rarely, stunted specimens growing on the rocks. Mr. Gower Wilson pointed out wide reefs on the shore side of the lagoon, which, he informed me, had been covered with *Hormosira* till within the last two or three years, but that it had been cropped bare by shoals of Nannewai, a long dark fish locally known as "Stinkers". It seems that these fish had quite suddenly developed a liking for the *Hormosira* and had made a clean sweep of it.

I found *Hormosira* on the mud-covered rocks of Oyster Harbour, King George's Sound, but not further west. It is common on the coast of New South Wales, as far north as Port Stephens, but seems to be replaced by its congener *H. articulata* (Forsk.) Zan. in Queensland. Abundant in South Australia, Victoria and Tasmania, and New Zealand.

GYMNOSORUS J. Ag.

GYMNOSORUS NIGRESCENS (Sond.) J. Ag.

Common. In the warmer waters of Australia, not extending to Tasmania. R. M. Laing records it from the Kermadec Islands, about in the latitude of Lord Howe, but not from New Zealand.

PADINA Adans.

P. pavonia (L.) Lamour. is found freely on the rocks about low-tide level. There seem to be but slight differences in the Padinas of Australian coasts, and I am inclined to follow Harvey in referring them all to *P. pavonia*. The Lord Howe plants are large, to 10 cm. high, and of a brown colour, neither very dark nor very light, less pruinose than the British form. While occurring on all Australian coasts, it does not seem to have reached Tasmania. Laing does not include it in his List of New Zealand Marine Algae.

HALISERIS Targ.-Tozz.

Two species are found at Lord Howe Island, *H. crassinervia* Zan. and *H. plagiogramma* Mont. Both grow on coral boulders and rock on the floor of the lagoon, usually singly, but here and there in groups. Both are plentiful, and most of the plants bore spores at the time of our visit, May, June, July.

HALISERIS CRASSINERVIA Zan. Pl. vii, fig. 1.

H. crassinervia was described by Zanardini, 1874, in his "*Phyceae Australicae novae vel minus cognitae*". Lord Howe is the only locality given for the plant. The description is meagre and the fruits are left as unknown. De Toni and Levi

studied the material in Zanardini's herbarium, and De Toni (*Sylloge*, iii, p. 258) comments as follows: "Species inter maximas enumeranda. Cum *H. australis* Sond. haud male quadrat sed lamina evenosa crassiuscula exsiccatione fuscescente costaque valde conspicua robustiori nigrescente procul dubio diversa." It in truth is very much closer to *H. pardalis* Harv. than to *H. australis*. *H. pardalis* and *H. crassinervia* are both veinless and both have the same fructification.

Attached by a swollen stupose base, the terete slender stipes soon forks into several times dichotomous fronds. Below, the divisions lose their laminae, which are gradually eroded and finally leave the ragged or bare costae to function as prolongations of the stipes. The higher branches divide repeatedly into segments with not very wide axils, and spread in all directions to form a broad and high clump. The length of a single frond ranges to 23 cm. The upper segments maintain a very uniform width of 10 or 12 mm., the ultimate ones long, undivided to a length of even 25 mm. Apices very obtuse, rounded. The colour is brown-olive, rather darker on drying. The substance of the laminae delicately membranaceous, while the midrib, composed of several layers of longer narrow cells, is conspicuous and firm, and deeper in colour but not nigrescent.

The spores are distributed in bands about 1 mm. wide, which spread in a curve backward from the midrib nearly to the margin. These bands, separated by barren spaces about 2 mm. wide, appear in opposite pairs on the whole frond in the mature plant, from close under the apices of the ultimate segments down to the lowest undivided lamina. The spores, of a yellowish-olive when seen by transmitted light under a high power of the microscope, are scattered over the bands singly, but in large numbers, and are round, about 87μ in diameter, including the narrow transparent perispore. Among them, confined to the bands, short irregular chains of smaller darker cells, 17.5μ in diameter, sometimes occur. What their nature may be I cannot say.

It is obvious that *H. crassinervia* is very closely related to *H. pardalis*. The former has a stouter costa, the segments are less patent, and the colour is darker, not "a bright yellowish olive" which Harvey attributes to *H. pardalis*. It may be owing to the long geographical insulation of Lord Howe that these small differences have been developed; and it is perhaps most convenient to give to it a distinct name to distinguish it from its far distant relative of Western Australia. Harvey found *H. pardalis* at Fremantle. I have received it from Dongarra, south of Geraldton, and from Broome on the N.W. Coast.

HALISERIS PLAGIOGRAMMA Mont. Pl. vii, fig. 2.

Originally described by Montagne from Cuba. Apart from West Indian and adjacent habitats, De Toni records the species from the Sandwich Islands and Australian shores, basing the latter record on material in the Zanardini Herbarium. I know of no occurrence in any part of Australia except Lord Howe Island.

H. australis Sond. and *H. plagiogramma* have fronds in which, in addition to the midrib, the fronds are strengthened by numerous thin veins running obliquely from the midrib to the margin, and are thus quite distinct from all other Australian species of *Haliseris*.

The fruits of *H. australis* are unknown, so that it remains to be seen whether they are arranged in parallel curved bands as in *H. pardalis* and *H. crassinervia*, or in sori forming a sub-continuous cloud of spores on either side of the midrib as in *H. plagiogramma*.

H. plagiogramma grows in the lagoon in the same manner as *H. crassinervia*, and often in association with it. It is of smaller dimensions, attaining a maximum height of 17 cm., but usually shorter, 12-14 cm. The ultimate segments are nearly as broad as long, 3 to 5 mm. The bifurcations are patent, the apices rounded obtuse, and the colour rather lighter than in *H. crassinervia*. The spores are of the same size and shape as in that species, 87 μ , with a clear border, but they are arranged in a long sorus adjacent to the midrib (as in *Blechnam*).

A. D. Cotton described a *Haliseris* collected in the Kermadecs by Miss E. M. Smith, in his paper on the "Marine Algae from the North of New Zealand and the Kermadecs" (*Kew Bulletin*, No. 61, 1912, p. 263). The Kermadecs lie in about the same latitude as Lord Howe and Norfolk Islands, many hundred miles to the east of the latter, and in a direct line between the Tongan Group and the North Island of New Zealand, nearer to the former. Lord Howe, Norfolk and the Kermadecs are all volcanic and form a natural region. Lord Howe has coral reefs well developed, which the others lack.

Cotton describes his species, *H. kermadecensis*, as a new form distinguishable from *H. australis* and *H. plagiogramma*. It is evidently very closely connected, if not identical, with the Lord Howe plant. His description is as follows: "15-18 cm. alta, basi eximie stiposa, plerumque stipite longo ramoso suffulta, sensim in segmenta dichotoma sinibus acutis abiens. Segmenta 5-8 mm. lata, linearia, venosa, apice attenuata, margine integerrima. Venae distinctae circ. 1 mm. distantes, a costa ad marginem oblique excurrentes. Tetrasporangia in soro elongato collecta. Oogonia ignota."

Our Lord Howe form, forma *Howensis*, differs in the markedly rounded, not acute, axils and the blunt rounded, not attenuate, apices.

I forwarded a Lord Howe plant to Dr. Cotton at Kew, and he writes: "We have looked at your specimen, and it is certainly distinct from my *Haliseris kermadecensis*. I am, however, not quite certain as to what it actually is, but it agrees well with our series of *H. plagiogramma* which we have represented from Australia."

Since writing the above I have received from Dr. Børgesen a copy of his paper on "Some Marine Algae from the northern part of the Arabian Sea, with remarks on their geographical distribution", 1934. In this he records *Dictyopteris australis* Sonder from the Indian coast at Dwarka, Okha Point, and Karachi. Dr. Børgesen's work has revealed an extraordinary extension of supposedly exclusively Australian algae into the Arabian Sea, and is of immense interest to an Australian worker.

The question of correct nomenclature has been raised. Targioni-Tozzetti gave the name *Haliseris* to the genus apparently about 1819 (1819? De Toni), and this has been in constant use for over a century. But the names *Neurocarpus* Web. & Mohr 1805, *Dictyopteris* Lamouroux 1809, and *Polypodoidea* Stackhouse 1809 would seem to have rights of priority. Setchell adopts *Neurocarpus*, and it would seem on good grounds, but Børgesen, in the paper above quoted, prefers *Dictyopteris*. An Australian worker is not in a good position to decide in matters of priority, so I am employing the well-known name *Haliseris* in this paper.

DICTYOTA PROLIFICANS A. & E. S. Gepp.

Abundant on the shore reefs at low-tide level, and well in fruit. The typical surface proliferations present.

I have also several fruiting specimens collected by Mr. R. Baxter on Lord Howe in 1922, the month not specified.

D. prolificans was described from New South Wales material, forwarded by myself, in the *Journal of Botany*, 1906. I have gathered it on the ocean coast of New South Wales from Long Bay, near Sydney, and at Narrabeen, as also at Caloundra, in South Queensland. Harvey gathered it at Newcastle, labelling it *D. Kunthii*. R. M. Laing gives it from the Kermadecs. It is undoubtedly *Dictyota* in structure and not *Dilophus*, as apparently suggested by Laing for the Kermadec plant.

I may add to the original description that the attachment is fibrous, as in *D. radicans* Haw., and not stupose.

DICTYOTA SANDVICENSIS Sond. (?)

Small plants to 8 cm. high, stupose at base, much divided dichotomously, with narrow linear segments, rather acute apices, spores conspicuous, 80–85 μ diameter, in irregular sori scattered over the whole interior area.

D. sandvicensis is recorded from Cape York and the Gulf of Carpentaria, and from the Red Sea.

DICTYOTA RUGULOSA, n. sp.

Fibrous, much-branched stoloniferous radicles. Plants gregarious. From the tangled attachment spring simple or forked linear fronds to 10 cm. long and 3–5 mm. wide, much crinkled transversely, with obtuse rounded apices. No surface proliferations.

Typical *Dictyota* structure. Interior a single layer of large empty colourless cells; no intermediate cells; cortical monostromatic layer of small dark brown cells, about 4, bordering each external margin of the interior cells.

Spores about 8.7 μ diam. scattered over the median area of the frond.

Frondes gregariae, radiculis fibrosis stoloniferis affixae. Frondes e plexu basali simplices vel furcatae exsurgant, lineares ad 10 cm. altae, 3–5 mm. latae, valde transverse rugosae. Apices rotundato-obtusi.

Structura duobus stratis, interiori magnis vacuis, cellulis monostromatica, corticali parvis obscure brunneis cellulis monostromatica; circiter 4 corticales cellulae insident supra marginem singulae medullaris cellulae. Sporae supra mediam regionem frondis sparsae, circ. 8.7 μ diam. Color olivaceo-brunneus.

Species of the *D. dichotoma* group of *Dictyota* are notoriously difficult to place accurately. The above small and simple crinkled form, occurring, so far as I know, only at Lord Howe, seems to me to be best considered for the present as a distinct species.

DICTYOTA FURCELLATA Ag. (?)

A species of *Dictyota* was abundant in the lagoon, growing mostly as an epiphyte on other algae, in dense intricate little bushes of 7–10 cm. high. The fronds, repeatedly and regularly forked, were remarkably slender, from 0.4 to 1.3 mm. in diameter, those of the same bush fairly uniform in width. Not fenestrated. The cells, twice as long as broad, closely parallel. No fruits or paraphyses seen.

C. Agardh gave the name *Dictyota furcellata* to a plant obtained by Gaudichaud from New Holland. It is described as having very narrow (*angustissimis*) fronds with no conspicuous areoles, much divided above the middle, and bearing fertile cells scattered over the median part of the frond, but (somewhat contradictorily) seriate in several lines. No dimensions are given.

Harvey, with some doubt, ascribed the plant which he found in abundance in King George's Sound to Agardh's *D. furcellata*. Later, J. Agardh transferred it to his new genus *Pachydictyon* as *P. furcellatum*. He distinguished *Pachydictyon* as having three layers in the frond, an intermediate, at length pluriseriate region lying between the monostromatic internal large cells and the monostromatic cortical cells.

Our Lord Howe plant is a *Dictyota*, and it may be *D. furcellata*, but in the absence of fruits the identification would be premature.

GLOSSOPHORA J. Ag.

GLOSSOPHORA HARVEYI J. Ag.

Densely spongiöse attachment 15 mm. across passing into a narrow terete stipes of about 3 mm. diameter, also stupose. The frond forks above this and compressed and then flattened passes by 4, 5 dichotomies into digitately spread laciniae. The laciniae flat, linear or strap-shaped, to 10 in. in length, and an inch in breadth, with entire margins and blunt or but slightly attenuated apices. Colour dark brown, becoming black on drying.

Structure of the frond showing an interior 3 or 4 layers of large colourless thin-walled cells and a cortex of small quadrilateral deeply coloured cells, arranged in quadrangular groups as seen from the surface.

In the winter months the plants only rarely bore the surface folioles in which the fruiting organs appear; in a specimen gathered by J. H. Maiden in March, the folioles closely covered the surface.

Hitherto only known from New Zealand and the Chatham Islands.

ECKLONIA Hornem.

ECKLONIA RADIATA (Turn.) J. Ag.

E. radiata does not appear in the lagoon, but grows at some depth, 10 fathoms, on the outside of the coral reef. It was of the typically smooth form, not forma *exasperata*.

A similar, but young plant, was similarly found growing on the cable at a depth of 20 fathoms off Norfolk Island.

It is common in Port Jackson and on the coast of New South Wales. Also in New Zealand.

MACROCYSTIS Ag.

MACROCYSTIS PYRIFERA (Turn.) Ag.

We did not see any plants, but I was assured by Mr. Gower Wilson, a deep-sea fisherman of much experience, that in former years it flourished in the deeper water outside the reef.

Lord Howe is the most northerly habitat noted for *M. pyrifera*. It is abundant on the rocky coasts of Victoria and Tasmania, but has not extended west of Cape Northumberland and not up the coast of New South Wales. It is also a New Zealand kelp.

COLPOMENIA Derb. et Sol.

C. sinuosa (Roth.) Derb.—Not uncommon on the reefs.

HYDROCLATHRUS Bory.

H. cancellatus Bory.—A number of plants seen.

Both *Colpomenia* and *Hydroclathrus* range over the south and east coasts of Australia, from the tropics to Bass Straits. Both are cosmopolitan genera, each of only one species. *Hydroclathrus* is not recorded from New Zealand.

ECTOCARPUS Lyngby.

ECTOCARPUS CONFEROIDES (Roth.) Le Jolis.

Two plants were gathered, about 10 cm. in height. Both were fawn-brown, drying a bronze-green. Both bore plentifully plurilocular sporangia, in each case cylindrical, sessile and without pilum. In the one the sporangia measured $140\text{--}200\mu \times 21\text{--}28\mu$, in the other the sporangia were shorter, $105\mu \times 28\mu$.

ECTOCARPUS SORDIDUS HARV.

Covering other algae in a dense dull-green untidy tangle, closely attached by many radicles to the host. Irregularly and frequently branched at wide angles; branchlets short. Fila $15\text{--}30\mu$ in diameter, joints of the larger constricted at the joinings, as long as broad. Plurilocular sporangia, few seen and not very distinct, sessile, about 35μ long.

Harvey's description of *E. sordidus* from Georgetown, Tasmania, is meagre and gives no measurements, but the present plant agrees very well with specimens we had gathered of *E. sordidus* in the type-locality.

Of the Brown Algae we may remark that the large southern kelps, *Ecklonia* and *Macrocystis*, occur only in the deeper waters which surround the island and its reefs, while *Arthrophyucus*, the southern subgenus of *Sargassum*, is altogether wanting. *Glossophora Harveyi* is the only characteristically New Zealand alga which we found established in Lord Howe.

The forms described as peculiar to the island are the Phyllotrichous *Sargassum Howeanum*, a form of *Cystophyllum muricatum*, with single, not seriate, vesicles, and Zanardini's two species of *Haliseris*.

RHODOPHYCEAE.

- | | |
|---|---|
| <i>Bangia</i> (?) <i>simplex</i> , n. sp. | <i>Delisea pulchra</i> (Grev.) Mont. |
| <i>Helminthora tumens</i> J. Ag. | <i>Asparagopsis taxiformis</i> Mont. |
| <i>Liagora Howensis</i> , n. sp. | <i>Laurencia majuscula</i> Harvey. |
| <i>Galaxaura rudis</i> Kjellmann. | <i>L. elegans</i> , n. sp. |
| <i>G. fastigiata</i> Dene. | <i>L. concinna</i> Mont. |
| <i>G. tumida</i> Kjellm. | <i>Acanthophora orientalis</i> J. Ag. |
| <i>Gelidium Maidenii</i> , n. sp. | <i>Polysiphonia implexa</i> H. & H. |
| <i>G. australe</i> J. Ag. | <i>P. Baxteri</i> , n. sp. |
| <i>Pterocladia lucida</i> (R. Br.) J. Ag. | <i>P. Gelidii</i> Zan. |
| <i>P. capillacea</i> (Gmel.) Bornet & Thuret. | <i>Amansia glomerata</i> Ag. |
| <i>Gymnogongrus irregularis</i> Zan. | <i>Enantiocladia Robinsonii</i> (J. Ag.) Falk. |
| <i>Mychodea halymenioides</i> Zan. | <i>Dasya fruticulosa</i> , n. sp. |
| <i>M. Zanardini</i> De Toni & Levi. | <i>Euptilota formosissima</i> (Mont.) Kuetz. |
| <i>Eucheuma spinosum</i> (L.) J. Ag. | <i>Ceramium Setchellii</i> , n. sp. |
| <i>Areschougia laurencia</i> (H. & H.) Harvey. | <i>Halymenia</i> (?) <i>multifida</i> Zan. |
| <i>Sarcodia ciliata</i> Zan. | <i>H. fimbriata</i> Zan. |
| <i>Sarcocladia</i> (?) <i>rhizophora</i> , n. sp. | <i>Carpopeltis Phyllophora</i> (H. & H.) Schmitz. |
| <i>Gracilaria Howensis</i> , n. sp. | <i>Peysommelia</i> sp. |
| <i>Hypnea seticulosa</i> J. Ag. forma | <i>Lithothamnion</i> |
| <i>H. Cenomyce</i> J. Ag. | <i>Goniolithon</i> |
| <i>Champia parvula</i> (Ag.) J. Ag. | <i>Melobesia</i> |
| <i>Plocanium hamatum</i> J. Ag. | <i>Amphiroa Howensis</i> , n. sp. |
| <i>P. leptophyllum</i> Kuetz. | <i>Jania rubens</i> Lamour. |
| <i>P. angustum</i> (J. Ag.) H. & H. | <i>Coralina chilensis</i> Dene. |
| <i>Martensia speciosa</i> Zan. | <i>C. rosea</i> Lamarck |

BANGIA Lyngb.

BANGIA SIMPLEX, n. sp.

Gregarious clumps of unbranched filaments, each clump springing from a small disc attached to worn stems of *Zostera*. Filaments to 4 cm. long, free, nearly uniformly cylindrical, except tapering at the very base, diameter 40–50 μ , transversely divided by colourless partitions about 14 μ apart. Each compartment so formed encloses within a wide colourless border a disc 10 μ long (in the direction of the filament) and as broad or a little broader. The discs are rose-coloured. They soon divide into two, a new partition of the frond forming pari passu with the division of the disc, and thus the filament increases in length by intussusception. When the frond is crushed the discs are seen to be circular. The whole filament constitutes a single series of discs.

Filamenta simplicia, gregaria, epiphytica basali communi disco affixa, 4 cm. longa, basi attenuata, cylindrica, 40–50 μ diam., transverse partita septis circ. 4 μ distantibus. Cellulae sic formatae intra marginem latum transparentem discum centralem roseum ad 10 μ longum praebentes.

Only seen by me on Lord Howe. The colour in mass is a dark rose-violet.

HELMINTHORA J. Ag.

HELMINTHORA TUMENS J. Ag.

Two forms were gathered. One, growing on coral lumps in the lagoon to a height of 15, 16 cm., with coarse divaricate much divided branches; the other, growing in pools on the Blinkenthorpe Beach, with many erect branches rising close together from a broad basal attachment to a height of 30 cm., clothed with numerous short slender lateral ramuli spreading in all directions. Both very mucilaginous and slimy.

Agardh separated the Australian plant from the *H. divaricata* of Europe, especially noting the swollen even globose terminal joints of the peripheral filaments. He worked on plants gathered in Port Phillip. I have found it myself at Portsea, near the Heads.

LIAGORA Lamour.

LIAGORA HOWENSIS, n. sp.

Frond 7 or 8 cm. high, of a densely fruticulose habit with fastigate branches. The lower main divisions regularly dichotomous, then these bear numerous pinnate branches of various length at short intervals, mostly alternate, with wide axils; in the upper parts of the branches of various orders more regular dichotomies again prevail, and the apices are regularly forked with divergent segments. The diameter of the stem and main branches about 1.5 mm., of succeeding divisions mostly 1 mm. All parts are coated with a continuous calcareous crust, smooth, wrinkled and occasionally rugose-annulose, so that on drying under pressure the plant does not in the least adhere to the mounting paper (in marked distinction to *L. Cheyneana*, *L. Harveyana* and *L. Wilsoniana* of Australian coasts). So impregnated is the plant with carbonate of lime that bleached specimens resemble Corallines in stiffness and fragility.

The frond has the characteristic axial longitudinal filaments, the exterior ones bearing at right angles densely crowded radial filaments. These have a pedicel or unbranched basal portion, which then forks a number of times, the diameter of these pedicel and lower forks about 6 μ , with colourless joints to 35 μ long. These branches fork a number of times, the last forks consisting of

strings of elliptical or globose cells, 2 or 3 in a string of about 3μ diam. These are densely packed in heads and are deeply coloured.

Unfortunately I have not observed any fruiting organs.

Frons 7, 8 cm. alta, dense fruticulosa ramis fastigiatis, inferne dichotoma, tunc pinnata, superne dichotoma, crusta calcarea continua investita. Diam. caulis ramorumque majorum 1.5 mm., ramorum secundariorum 1 mm. Apices furcati. Frons teres, levis, rugosa vel nonnumquam rugoso-annulata. Structura praebet axilla filamenta longitudinalia crebris radialibus filamentis horizontalibus. Filamenta radiantia pedicellata, repetite furcata, dense aggregata. Ultimae furculae moniliformes, 2, 3 cellulis sphaericis coloratis 3μ diam. constitutae.

The genus *Liagora*, widely dispersed in the warm seas of all the oceans, is particularly difficult to classify, because the "species" run into one another so greatly. De Toni in his *Sylloge*, Vol. iv, gives a classification based on J. Agardh (*Anal. Alg.*, iii), but in Vol. vi he gives no classification.

By Professor Setchell I have been favoured with an arrangement of the species based on the researches of Howe and himself. In this the primary divisions are:

I. *Dichopodiales*.

1. *Dichotomae*.—Truly and regularly dichotomous, ending in short furcations. Type, *T. valida* Harv.
2. *Subdichotomae*.—Dichotomies regularly and strongly unequal, giving a dichotomo-pinnate habit; apices longer or shorter furcate Type, *L. farinosa* Lamour.
3. *Adventitioramae*.—Regularly dichotomous, with short lateral simple or slender dichotomous adventitious ramelli . . Type, *L. distenta* (Mert.) Ag.

II. *Monopodiales*.

4. *Pinnatae*.—Frons monopodial, pinnate Type, *L. pinnata* Harv.

The Lord Howe plant seems to find a place in the *Subdichotomae*, though it shows closer affinities to *L. rugosa* Zan. than to *L. Cheyneana* (which Howe includes in *L. farinosa*) in its more regular dichotomies, its continuous calcification, its fastigiate habit and its robustness. I think it best to consider it as a distinct species. It does not agree with any of our other Australian forms and the Lord Howe Flora has a remarkable individuality of its own.

In Australia, *Liagora* is abundant in the tropical and subtropical waters, but also occurs in fair quantity on all the southern coast from Rottneest to Western Port. It has been found in Tasmania.

GALAXAURA Lamouroux.

GALAXAURA RUDIS Kjellman.

A coarse plant attached by a small disc to a fragment of *Goniolithon*. Almost equally thick from base to apices, diam. about 1.5 mm. Branches very numerous but leaving the principal axis evident in the lower part. Branching pinnate, more dichotomous above. Branches with a nearly continuous incrustation of lime, penetrated by the close short pila. Colour of specimen pinkish-grey. Height 12 cm.

The Friendly Islands are the habitat quoted for the species. Coarse fibres, large exterior cells.

GALAXAURA FASTIGIATA Dene.

Frond repeatedly forked, to 10 cm. high, axils fairly open, articulate; joints cylindrical, a little over a millimetre in diameter, the ultimate forks slenderer, 5-8 mm. long or a little more, the joints distinct but very narrow, often annulate-rugose, smooth with no hairs, strongly imbued with carbonate of lime and hence brittle. Colour purplish-pink.

Assimilatory filaments free beyond the basal tela, forked, composed of few cells, the penultimate often bearing two smaller ones, penultimate cells 24μ diam.

Characteristic cystocarps were seen.

The common *Galaxaura* of the Island, gathered at low water on the reef in abundance.

It clearly belongs to the *Eu-Galaxaura* group and is closely related to *G. fragilis* (Lamarck) Kuetz. of the West Indies. It is difficult to decide whether to assign it to *G. eburnea* Kjellm. from Queensland and Timor, or to *G. fastigiata* Dcne. from New Caledonia. I incline to the latter from the larger size and the more distinct annular rugulosities. Our plant is rather slenderer than both of the named species.

GALAXAURA TUMIDA Kjellm.

Frond regularly forked, spreading from a thickened attachment, loose, articulate with distinct joints. Joints obovoid or ellipsoidal, swollen, rounded at both extremities, 2-4 times as long as broad, diameter in the neighbourhood of 3 mm., mostly transversely wrinkled, thickly membranaceous, imbued freely with carbonate of lime but not so as to become brittle. Collapsible.

Colour a pinkish-fawn (beige).

Interior lax long hyaline fibres, exterior a tela of angular cells often with a rose-coloured chromatophore, 24μ in diameter, projecting in free round summits above the surface. I could not see definite fila assimilatoria.

Two plants were gathered in a wet place on the reef; 4 or 5 cm. high. No fruiting organs observed.

The plant belongs to the Cameratae group and agrees best on the whole with Kjellman's description of *G. tumida*, which is in the Areschoug Herbarium as sent by F. von Mueller from "Habrone Bay, New Holland". I cannot find the whereabouts of this locality.

I have the same plant from Norfolk Island, determined by Reinbold as *G. obtusata* (Soland.) Lamour.

GELIDIUM Lamouroux.

GELIDIUM MAIDENII, n. sp. Pl. vii, fig. 3.

From a plexus of stiff radical fibres rise several independent fronds, some of which attain a height of 37 cm. The axis continuous from base to apex of the frond, compressed; the lower half, stipes, 1-1.5 mm. in diameter, almost entirely bare with a few scattered abortive spinous processes, 1-2 mm. long; the upper half, rachis, distichously pinnate. Pinnae opposite or subopposite, patent, 3-5 mm. distant, to 8 cm. long, the compressed rachis percurrent throughout, bearing subopposite distichous pinnules separated by distances of 2, 3 mm. Pinnules to 5 mm. long, similarly again distichously pinnulate or bi-pinnulate. Ultimate segments short, flat, obtuse.

Structure: An interior core of densely packed colourless fibres occupying most of the rachis, with a few coloured rounded cells involved in the outer zone and an external cortex of compacted vertical series of small coloured cells. Eminently cartilaginous, not adhering to the paper when dry.

Colour a dark purple, fading through brown to a lutescent flesh colour.

Frondes plures e plexu radicali exsurgentes, compressae, axi continuo percurrente, ad 37 cm. altae. Inferne stipes planus longus, 1-1.5 mm. latus, fere nudus; superne rachis distiche pinnata. Pinnae oppositae vel suboppositae,

patentes, 3-5 mm. distantes, rachide compressa, ad 8 cm. longae, distichosis pinnulis 2, 3 mm. distantibus. Pinnulae pinnulatae vel bipinnulatae ad 5 mm. longae. Segmenta ultima brevia, plana, obtusa. Medulla fibris confertis maxime evoluta; cortex cellulis parvis coloratis verticaliter seriatis. Substantia cartilaginea. Color obscure purpureus.

Collected by J. H. Maiden in March, 1898.

GELIDIUM AUSTRALE J. Ag.

A small plant, 7 cm. high, collected by F. A. McNeill in May, 1932.

Common in Victoria and Tasmania, also in Botany Bay and Port Jackson.

PTEROCLADIA J. Ag.

PTEROCLADIA LUCIDA (R. Br.) J. Ag.

Abundant near the South Reef. Some coarser plants of the Western Australian type, but most were more compoundly pinnate with extremely fine terminal divisions. Unfortunately it proved to be the season of tetrasporangia. I could not find a plant bearing cystocarps. I think that there must be a definite season, the autumn, for the production of cystocarps. The only so-fruited specimens among the many which are in my herbarium are some gathered at Kiama, N.S.W., in April.

Reinhold determined certain plants sent to him from Norfolk Island as *Gelidium rigidum* (Vahl.) Grev., but did not recognize *Pterocladia lucida* in the collection. I have not seen authentic specimens, but the description accords well with the majority of the Lord Howe plants, and apparently only tetrasporangiferous plants of the *Gelidium* are recorded. Whether or not I am correct in assigning the Lord Howe plants to *Pterocladia* must remain doubtful until the cystocarps have been obtained. De Toni quotes tropical stations for *G. rigidum*, the only Australian record being the island of Toud, which lies in Torres Strait.

PTEROCLADIA CAPILLACEA (Gmel.) Bornet & Thuret.

Common on the floor of the Lagoon. Also from Norfolk Island (Reinhold).

GYMNOGONGRUS Mart.

GYMNOGONGRUS IRREGULARIS Zan.

Zanardini's description may be rendered: Frond setaceous; low, irregularly pinnately branched; branches issuing in all directions, alternate, opposite or more often secund, the ultimate branches short, issuing horizontally in the form of spines; apex obtuse; fruits unknown. Colour atro-purpureous.

Collected by Fullagar and Lind.

MYCHODEA Harvey.

We saw no examples of this genus. Zanardini, however, described two species from Lord Howe.

M. natymenioides Zan.—De Toni cites the same also from "Swan Island", Australia (J. Agardh). This may refer to the island of that name, which lies in Port Phillip near the Heads.

M. fastigiata Zan.—As this specific name had already been bestowed on another species, De Toni and Levi have given it another, viz., *M. Zanardini* De Toni and Levi.

Mychodea is a characteristic Australia-Tasmanian genus. Kylin (Die Florideen-ordnung Gigartinales, 1932) enumerates 14 species, all from this region.

He does not mention *M. Zanardinii*, but lists and figures *M. halymenioides* from the "Swan Island" example in the Agardh Herbarium at Lund.

De Toni records an example of *M. foliacea* (Harv.) J. Ag. collected at Port Chalmers, New Zealand, by Dr. G. Capra. This is, as far as I know, the only known occurrence of *Mychodea* outside Western and South Australia and Tasmania. De Toni and Forti, "Alge di Australia, Tasmania and Nuova Zelandia", 1923.

EUCHEUMA J. Ag.

EUCHEUMA SPINOSUM (L.) J. Ag.

Collected by J. H. Maiden in March, 1898. Sterile. A tropical species in Sumatra, Papua and tropical Australia, extending to Japan in the north, and, it would seem, to Lord Howe in the south.

The Eucheumas are eminently gelatinous. *E. speciosum* (Sond.) J. Ag. occurs freely in Western Australia, and *E. gelatinae* (Esp.) J. Ag. is recorded from northern Australia and New Caledonia and (fide Grunow) extends to Japan.

ARESCHOUGIA Harvey.

ARESCHOUGIA LAURENCIA (H. & H.) Harvey.

(= *A. gracilarioides* Harv.; = *A. congesta* J. Ag.).

FORMA LONGIRAMEA, forma nova.

It was a surprise to find this genus represented at Lord Howe. All our described species live on the west and south coasts of Australia and in Tasmania, *A. laurencia* occurring throughout. Laing records it from New Zealand. We gathered two well developed specimens about 20 cm. in length. They differed from typical Tasmanian plants in the greater length and looseness of the branches, being much less bushy and recalling somewhat the habit of *Gracilaria lichenoides*; further, the intermediate zone between the axile tube and the cortex is much more developed, strings of fairly large coloured cells passing outwards, among which the colourless filiform branches of the axile tube are difficult to follow in the cross-section. In *A. laurencia* this zone is occupied by the filiform branches, and fills an extensive area. In both forms the stems and branches are terete. For the present I think it had better be described as a form of *A. laurencia*, produced during long isolation at Lord Howe.

SARCODIA J. Ag.

SARCODIA CILIATA Zan.

Common on and around the reefs and rocks at 1 or 2 fathoms. Colour red, fading into yellow, often conspicuously yellow when viewed from a boat.

Tetraspores remain to be seen.

So far as is known, endemic to Lord Howe.

SARCOCLADIA HARV.

SARCOCLADIA (?) RHIZOPHORA, sp. indescript. Text-fig. 6.

Prostrate rosette-like expansions of 5, 6 cm. in spread, consisting of a few layers of overlapping radiating regularly dichotomous fronds. Fronds flat, compressed, 2 mm. diam., below, may diminish to 0.5 mm. in ultimate segments, but in general fairly uniform. Axils wide, apices obtuse, almost absciss.

An extraordinary feature is the great number of cylindrical processes issuing from the whole under surface of the frond. These rise in small mamillae and may grow to a length of 5 mm. or more, mostly quite free, but occasionally are found attached at the extremity to the substratum. They seem to be clearly

organs for attachment, and may be considered as adventitious rhizoids. Frond cartilagino-coriaceous, does not adhere to the paper. Colour dark-red when fresh, turning black when dry.

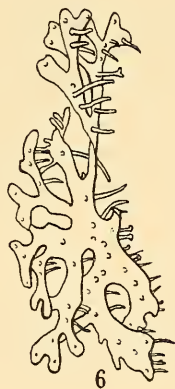
The cross-section shows a Gracilarioid structure, entirely cellular, the innermost cells colourless, scarcely larger than those externally adjacent to them; these and the smaller, but not minute cortical cells, are deeply coloured.

Planta prostrata in rosetta, 5, 6 cm. diam., duobus vel tribus stratis frondium superpositis consistens. Frons plana, 2 mm. lata, superne ad 0.5 mm. minuata, regulariter dichotoma, axillis latis, apicibus obtusis fere abscissis. De pagina inferiore dependent plures processus adventitii cylindrici crassi, ad 5 mm. longi, liberi vel matrici adhaerentes. Structura fere Gracilariæ, omnino parenchymatosa; cellulæ interiores majores, incoloratæ; cellulæ intermediae vix minores, coloratæ; cellulæ corticales minores, coloratæ, monostromaticæ. Substantia cartilagineo-coriacea. Color obscure ruber, in sicco niger.

No reproductive organs seen.

Growing sparingly on the reef.

I forwarded this plant to Prof. Setchell, and it is on his suggestion that I refer it to *Sarcocladia* with a query, and employ the specific name *rhizophora*. It may demand a generic name of its own, but in the absence of reproductive organs nothing more precise can be asserted.



Text-fig. 6.—*Sarcocladia* (?) *rhizophora* Lucas.

Text-fig. 7.—*Laurencia elegans* Lucas.

GRACILARIA Greville.

GRACILARIA HOWENSIS, n. sp.

Frond terete, flattening on drying, with a stipes about 1 cm. long, then dichotomous, divaricate, above with subsecundate branches; ultimate ramuli very patent, acuminate with broad base, inclined to be arcuate. Substance thick, succulent, fleshy, main branches about 2 mm. diam. Adheres to paper. Height to 8 cm. Colour a dark purple.

Interior cells thin-walled, numerous, gradually diminishing in size towards the submonostromatic coloured cortex. Neither cystocarps nor tetrasporangia seen.

It is unlike any of the Australian species, but in habit and dimensions recalls *G. dumosa* Harv., from the Friendly Islands. The cross-section of one of Harvey's specimens in the N.S.W. National Herbarium showed the interior cells much fewer, the central ones very large and much exceeding those exterior to them.

Frons teres, in sicco complanata, ad 8 cm. alta, stipite 1 cm. longo, dichotoma, divaricato-patens, ramis superioribus nunc subsecundatis. Ramuli ultimi patentissimi, basi lato, acuminati nunc arcuati. Rami majores 2 mm. diam. Cellulae interiores muris tenuibus crebri, gradatim minores versus corticem coloratum submonostromaticum. Substantia carnea-succulenta; planta siccata ad chartam adhaeret. Color obscure purpureus.

Fragments of other Gracilarias were seen, but not identified.

HYPNEA Lamour.

HYPNEA SETICULOSA J. Ag. (?)

I refer to this species a few caespitose plants, densely intricate and drying a very dark colour, abundantly provided with seticules. Height to 5 inches, with an equal spread. At all events they belong to J. Agardh's Section Spinuligeræ, and are very closely related to *H. seticulosa* and *H. divaricata*. Fruiting organs not seen.

HYPNEA CENOMYCE J. Ag.

Plants collected by R. Baxter in 1922, bearing the characteristic stout inflated apiculate branchlets with immersed tetrasporangia.

Recorded by De Toni from Australia, without more specific reference to locality.

CHAMPIA Desvaux.

CHAMPIA PARVULA (Ag.) J. Ag.

Occurring with the usual intricate branching.

If the Australian forms attributed to *C. parvula* are truly the same as the European and American, then the species is indeed cosmopolitan.

Harvey records it for west, south and east coasts of Australia, from Tasmania and New Zealand, and from the Friendly Islands. I have found it in fair abundance in the harbours of the east coast, Moreton Bay, Port Stephens, Port Jackson and Botany Bay.

PLOCAMIUM Lamouroux.

PLOCAMIUM HAMATUM J. Ag.

The commonest Red Weed of Lord Howe.

Originally recorded from Norfolk Island and the mouth of the Burnet River, Queensland. I have it also from Caloundra, Queensland.

Cystocarps not seen. Three or four plants bore poorly developed sporophylls carrying tetrasporangia.

Mr. Basset Hull gathered a plant bearing large sessile cystocarps at Caloundra in August, 1922, and Mr. J. H. Maiden at Lord Howe in March, 1898.

PLOCAMIUM LEPTOPHYLLUM Kuetz.

Collected by J. H. Maiden in March, 1898. Cast up. Sterile.

Australia, Tasmania and New Zealand.

PLOCAMIUM ANGUSTUM (J. Ag.) H. & H.

Collected by J. H. Maiden in March, 1898. Cast up. Ripe sporophylls present. Common in southern and eastern Australia and Tasmania, and it extends to New Zealand and the Chatham Islands.

DELISEA Lamouroux.

DELISEA PULCHRA (Grev.) Mont.

A luxuriant specimen collected by J. H. Maiden in March, 1898.

The finest plants grow on the coast of New South Wales, where it is abundant. Occasionally met with in Western Australia and round the south coast. R. M. Laing lists it from the Kermadecs and from New Zealand (De Toni says *rarissime*) and adds South Georgia and Graham's Land. Harvey, after Hooker, attributes it to Kerguelen.

ASPARAGOPSIS Montagne.

ASPARAGOPSIS TAXIFORMIS Delile (= *A. Delilei* Mont.).

Confirmed for me by Drs. Svedelius and Børgesen. It is extremely doubtful, indeed Harvey himself was doubtful, if *A. Sanfordiana* Harv. is distinct from *A. taxiformis*. As far as I can judge, the properties on which Harvey relied in his Western Australian species, viz., the great size (to 10 inches), the dark colour, much branched and developed surculi, comparative length of the naked portion of the stem, and the rounded tips of the tufts of ramelli, are all reproduced in the plants growing on the floor of the Lord Howe Lagoon at a depth of a fathom or so. Dr. Børgesen, who has observed *A. taxiformis* in the West Indies and Canary Islands, believes that it cannot be distinguished from *A. Sanfordiana*, and I do not think that the unarmed species which grows on the southern Queensland coast and Lord Howe differs materially from that which grows in Western Australia.

MARTENSIA Hering.

MARTENSIA SPECIOSA Zan. Pl. viii, fig. 1.

Not infrequent, growing on the reefs, especially in the larger pools.

Perhaps chiefly distinguished from its allies by the exiguous margins. Our largest specimen measured 8 cm. in length.

Zanardini apparently did not see tetrasporangiferous plants. We met, fortunately, with both cystocarpiferous and tetrasporangiferous individuals. The sporangia were scattered, immersed in the turgid transverse and longitudinal walls of the reticulum. Each sporangium was provided with a spherical colourless envelope, and divided into a tetrad of spores. Envelope about 105μ diam.

Apparently endemic.

M. elegans Hering is fairly abundant on the coast of New South Wales. Laing records it from the Kermadecs, quoting Oliver.

LAURENCIA Lamour.

LAURENCIA ELEGANS, n. sp. Pl. viii, fig. 2; Text-fig. 7.

A slender plant, 10 or 11 cm. high, with decompound pinnate ramification, the branches issuing in all directions, the lower ones as main axes. Diameter of the axis 700μ , and of the main branches rather less. Branches bearing numerous short alternate ramuli also issuing in all directions; ramuli with 3 or 4 segments, the segments similarly 3- or 4-lobed; ultimate lobes linear-oblong, with flat, blunt and thickened apices, surface cells somewhat projecting. Surface cells not palisade-like; no thickenings in the medullary or inner cortical cell-walls.

Fronds rather cartilaginous than soft, adhering closely to the paper. Colour purple-violet.

Tetraspores in all stages immersed in the lobes.

Cystocarps, on another plant, sessile, often in series, globular, containing stipitate pear-shaped spores rising from the basal placenta. Diameter 600 μ .

Found floating in drift, tangled with other algae.

Apparently allied to *L. nidifica* and *L. pannosa* and perhaps most closely to Yamada's *L. mariannensis* from the Marianne Group (Setchell).

Frons tenuis, 10, 11 cm. alta, decomposita pinnata, ramis quoquoversum emergentibus, inferioribus rachides majores informantibus. Stipitis diam. 700 μ . Rami crebris brevibus alternatis ramulis, quoquoversum divergentibus. Ramuli 3, 4 segmentis; segmenta 3, 4 lobis. Lobi ultimi lineari-oblongi, apicibus complanatis crassis obtusis. Cellulae superficiales in sectione transversali non radiatim elongatae; parietes cellularum medullariarum non incrassati. Cellulae superficiales apicum leviter prominentes. Substantia cartilaginea. Tetrasporangia in lobis immersa.

Cystocarpia sessilia, globosa, saepe seriata, 600 μ diam. Color purpureo-violaceus.

LAURENCIA MAJUSCULA HARV.

Yamada (Notes on *Laurencia*, with special reference to the Japanese species, 1931) considers that all the Australian forms referred to *L. obtusa*, var. *majuscula* Harv. and *L. dendroidea* J. Ag. are the same thing, and to be separated from *L. dendroidea* J. Ag. from Brazil. They agree in the absence of palisade cells in the cortex, and the absence of lenticular thickenings in the walls of the medullary cells, but the surface cells in the Australian form are projecting and in the Brazilian are not projecting. J. Agardh himself had some doubts when he assigned the Australian form to his *L. dendroidea*. Yamada raises Harvey's other Australian variety of *L. obtusa*, *L. obtusa* var. *regia*, to definite specific rank as *L. regia* Harv. I propose in the same way to separate the var. *majuscula* from the English *L. obtusa* (Huds.) Lamour., and to erect it into a definite species, *L. majuscula* Harv.

A handsome arborescent species, of a rich red-purple colour, growing to more than a foot in height, and one of the conspicuous Red Algae growing on the floor of the Lagoon. Harvey's description is "fronde sanguinea crassiore elata (6-8 uncias longa) densissime composito-pinnata, ramis ramulisque brevibus, creberrimis".

Harvey records it from Rottneest Island and King George's Sound in the west, and from Cape Schank, Victoria. I have it from the coast of Queensland from Bowen and Caloundra.

LAURENCIA CONCINNA Mont., 1842, from Toud Island. Pl. ix, fig. 1.

Growing luxuriantly in deeper water, to a height of 14 cm., and of a rich reddish-purple colour. We found stichidia in abundance but saw no cystocarps. In fact no cystocarps seem to have been observed in the West Indian or Australian plants.

L. concinna has a wide range in tropical and subtropical seas of Australia. In Harvey's Alg. Exsicc. Austr. there is a specimen from Fremantle, and I gathered it on Rottneest Island; d'Urville found it in Torres Strait at the "Isle Toud"; Yamada identified a specimen from Port Douglas in the Herb. Thuret in Paris; the Melbourne Herbarium has it from Keppel Island; I gathered it freely at Caloundra, and it grows in excellent condition at Lord Howe.

Yamada considers that all the forms of *L. concinna* are really identical with *L. Brongniartii* J. Ag. from Martinique in West Indies, and this name has priority. I am not convinced, however, after studying the descriptions given in De Toni's Sylloge (De Toni places them in different groups) and the figures given by Yamada of typical *L. Brongniartii* that the Australian is identical with the West Indian species, and therefore prefer to keep our Australian forms apart under the name *L. concinna* Mont.

POLYSIPHONIA Greville.

POLYSIPHONIA IMPLEXA H. & H.

A four-siphoned ecorticate form growing entangled among other algae. Joints short as, or shorter than, the breadth. Diameter of lower branches 225μ . Here and there producing adhesive discs. Colour very dark, almost nigrescent purple. Fronds caespitose, about an inch in height.

Hooker and Harvey described *P. implexa* on New Zealand material. Harvey detected it in King George's Sound.

POLYSIPHONIA GELIDII Zan.

Phyc. Austral. nov., 1874.—"Fronde parvula, tenuissima, repente, subdichotome ramosa, ramulis ultimis lateralibus subulato-attenuatis; articulis 4-siphoniis, primariis diametro sesqui-duplo longioribus, secundariis diametro subaequalibus; cystocarpis sphaeroideis, ad ramos sessilibus. Hab. in frondibus Gelidiacearum ad insulam 'Lord Howe'."

This form, which is preserved in Herb. Zan., would appear, from the above description, to be very close to, if not identical with, *P. implexa*. In the latter, however, the articuli are all about as long as broad. The cystocarps of *P. implexa* have not been described, and in neither have the tetrasporangiferous ramuli been observed. Further information is desirable.

POLYSIPHONIA BAXTERI, n. sp.

Growing as a fringe on a fruiting stem of *Gracilaria*. Diameter of branches from 150μ at base, diminishing upwards. Joints mostly 2×1 below, and of ultimate segments 1×1 . Four siphons. Cystocarps with a one-jointed pedicel, nearly spherical, 170μ diam. Height about 1 cm. Colour violaceous.

Collected by R. Baxter. A single specimen.

Frondes gregariae capillares in ramo *Gracilariae* epiphyticae. Rami ramulique acutis angulis alterne surgentes, basale diam. 150μ . Articuli basales 2×1 , ultimi 1×1 . 4 siphones. Cystocarpia uni-articulato pedicello suffulta, fere sphaerica, 170μ diam. Planta ad 1 cm. alta. Color violaceus.

AMANSIA Lamouroux.

AMANSIA GLOMERATA Ag.

Common on the South Reef; occasional on the eastern reefs, there dwarfed and stunted, cropped by animal life.

Base a disc. Stipes stout for the size of the plant, 2 mm. diam., terete and tough, to 12 mm. long, then branching with 3, 4 alternate divaricate terete branches to 15 mm. long. These sparsely divide in the same way. The secondary divisions bear near their apices, conglomerates of almost rosulate pinnae, folia. Folia sessile, flat, linear, to 14 mm. long, to 3 mm. broad, with marginal teeth and incurved rather obtuse apices. Midrib not apparent and no veins. The marginal teeth sometimes grow out into similar secondary folia, toothed like the

primary. Cells typical of the genus, large elongated hexagons in two layers, arranged in transverse zones. No cortex.

No cystocarps or tetrasporangiferous stichidia seen.

I referred an example to H. Kylin, who gives me the above determination.

It has not as yet been recorded from Queensland, but Sonder's *A. pumila* from Cape York comes near to it.

Widely distributed in the Pacific and Indian Oceans; Sandwich Islands (Gaudichaud), Samoa (Grunow), Friendly Islands (Harvey), Sulu (Falkenberg), New Caledonia (Vieillard), Mauritius, Madagascar, Dar-es-Salaam.

ENANTIOCLADIA Falkenberg.

ENANTIOCLADIA ROBINSONII (J. Ag.) Falk.

Originally described by J. Agardh from plants sent by Mr. Isaac Robinson from Norfolk Island. Our Lord Howe plants were, many of them, larger than those described from Norfolk, to a decimetre or more in length, and with a spread of 2 dm. Growing in abundance on the South Reef.

Enantiocladia Robinsonii is not confined to Lord Howe and Norfolk Islands. I gathered it at Caloundra, and Mr. H. A. Longman sent it to me from Noosa Heads, both on the South Queensland coast.

No cystocarps seen, and the slender branched marginal processes had developed no tetrasporangia. It appears to have been the wrong season of the year for the fruiting.

DASYA C. Agardh.

DASYA FRUTICULOSA, n. sp. Pl. ix, fig. 2.

Growing on coral boulders on the floor of the lagoon and on the piles of the jetty.

A delicate bushy plant, 10–13 cm. high, with an equal lateral spread. Attached by a disc from which rise several stems. Stems slender, about 300 μ diameter, smooth, for the greater part covered with branches issuing on all sides. Branches decompound pinnate, all closely corticate, except the ultimate ramuli which bear numerous dichotomous monosiphonious capillary ramelli forming long pencils. Five siphons. Siphons of the ramuli to six times as long as broad. Joints of the ramelli 3, 4 \times 1.

Stichidia broadly lanceolate, springing abruptly from a short 1–3-celled pedicel, long acuminate, often terminating in a monosiphonious filum which may have a length of one-fifth to one-half the length of the stichidium proper. The ripe sporangia biseriolate, with suppression of others in the same rank. Length of whole stichidium with filum 400–500 μ ; width to 75 μ .

Colour purple-crimson.

Perhaps nearest to *D. capillaris* Harv., but differing from it in the nearly complete cortication and bushy habit. *D. capillaris* from the Tamar is perflaccid, the ramelli extremely soft and tender, adhering so tenaciously to the paper that they cannot be removed on moistening without disruption, while those of the present species are readily detachable.

A. and E. S. Gepp (*Journal of Botany*, 1906) considered specimens of a *Dasya*, which I had sent them, to be the same as *D. capillaris* Harv. It is common in Botany Bay and occurs in Port Stephens. I have a specimen collected by Harvey in Port Jackson, which he labelled *Dasya* sp. It seems to me to be a form intermediate between *D. capillaris* and *D. fruticulosa*, but nearer to the latter. It is

the only *Dasya* which I know of from the east coast of Australia, with the exception of the little known *D. cuspidifera* of Sonder from the north-east.

Of the 46 described species of *Dasya*, 25 are resident in Australia-Tasmania. All of these are, so far, only known from Australia, except that *D. mollis* Harv. occurs in the West Indies, and *D. collaberis* H. & H. in New Zealand, while Yendo records *D. collaberis* and *D. elongata* Sond. from Japan.

Dr. Börgesen has recently described a new species of *Dasya*, *D. flagellifera*, from the Arabian Sea. He had previously recorded *Heterosiphonia Muellerei*, supposed to be exclusively Australian, from the same district.

Frons delicatula, fruticulosa, 10-13 cm. alta, aequaliter expansa. Rachides plures e disco communi exsurgunt. Stipes tenuis, 300 μ diam., glaber, ramis crebris quoquoversum emergentibus. Rami decomposito-pinnati, dense corticati. Ramuli ultimi articulati, ramellis crebris dichotomis, monosiphoniis, capillaribus penicillatis induti. 5 siphones. Articuli siphonum ramulorum 6 \times 1, ramellorum 3, 4 \times 1. Stichidia late lanceolata, pedicello brevi 1-3 cellulis suffulta, acuminata, in filum monosiphonium producta, 400-500 μ longa, 75 μ lata. Color obscure coccinea.

EUPTILOTA Kuetz.

EUPTILOTA FORMOSISSIMA (Mont.) Kuetz.

Single plant collected by J. H. Maiden in March, 1898. Known only from New Zealand and the adjacent islands. The specimen was clearly cast up on the beach and may have drifted from New Zealand waters.

CERAMIUM Wiggers.

CERAMIUM SETCHELLII, n. sp.

About 8 cm. high, altogether dichotomous, the lower forks at rather distant intervals, the branches free, erect. Diameter of the lower stem 230-250 μ . Upper divisions capillary. Lower joints to three times as long as broad, two-thirds of each naked, cortex of genicula sub-prominent; upper joints long as, or shorter than, broad, cortex confluent. The cortical bands are composed of crowded small coloured cells; in some genicula large colourless cells, often projecting, occur and give the band a heterocystid appearance, but I suspect these are foreign to the plant. Tetrasporangia periclinous, almost stalked, emergent. Colour pale purple.

Gathered floating among weeds carried in by stormy weather.

Not quite the same as any of the Australian Ceramia I have seen. As Prof. Setchell has pointed out, the plant belongs to the *C. strictum* and *C. diaphanum* group, and so is probably related to the Australian *C. aequabile*, to which J. Agardh gave the name without, however, giving the description.

I dedicate the species to Professor Setchell, who has given me much generous counsel with respect to the Lord Howe algae.

Frons ad 8 cm. alta omnino dichotoma. Dichotomia inferiora admodum distantia. Rami liberi, erecti, superiores ramulique capillares. Diam. partis inferioris rachidis 230-250 μ . Articuli inferiores 3 \times 1; duae partes cujusque nudaе. Articuli superiores diametro aequales vel breviores, cortice continuo investiti. Genicula plerumque cellulis minutis confertis coloratis composita; hinc et illinc cellulas majores transparentes saepe prominentes, forsitan peregrinas, praebentia. Tetrasporangia periclinia subpetiolata, emergentia. Color purpureus.

Order CRYPTONEMINAE.

HALYMENIA C. Ag.

The two following species were founded on plants from Lord Howe Island collected by Fullagar and Lind, by Zanardini in 1874. We did not see either.

HALYMENIA (?) MULTIFIDA Zan.

Frond flat, linear, stipitate-cuneate, gelatinous-membranaceous, dichotomomultifid, segments attenuated at the base, entire or with callous denticulations on the margin, apex obtuse. Colour vividly purpurascens. Fruits unknown. Frond rather thick.

Owing to the facies and substance being of *Callophyllis* and the structure of *Halymenia*, Zanardini thought that the plant might form a new genus.

HALYMENIA FIMBRIATA Zan.

Frond flat, linear-lanceolate, substipitate-cuneate, gelatinous-membranaceous, repeatedly dichotomous, segments linear-lanceolate, densely ciliate on the margin, apex obtuse, mostly bifid, the cilia short, at length elongated-strap shape. Frond thin. Colour a pleasant rose. Cystocarps scattered in the disc of the frond.

CARPOPELTIS.

CARPOPELTIS PHYLLOPHORA (H. & H.) Schmitz.

Two examples, intense red, some of the segments bearing fruiting *Melobesia*. A stout stipes, more than half an inch long; frond 5-6 inches long, irregularly dichotomous. No fruit.

"Clearly a *Carpopeltis*, and very close to, if not identical with, *C. Phyllophora*" (Prof. W. A. Setchell).

C. Phyllophora occurs in Western Australia and Tasmania, according to Harvey.

INCRUSTING CORALLINACEAE.

I do not venture to report on the incrusting Corallinaceae, though they are by no means lacking. The outer part of the south-eastern fringing reef is composed of a thick crust of a red *Lithothamnion*. The reef is treacherous, often roofing over a current of deep water and liable to give way under the tread. It is only exposed at the time of exceptionally low tides, and none such occurred during our visit. Lumps of *Goniolithon* were cast up. Species of *Melobesia* were gathered incrusting other algae, and bore conceptacles, but I cannot attempt to identify them. The field will doubtless be an ample one for an expert investigator.

AMPHIROA Lamouroux.

AMPHIROA HOWENSIS, n. sp.

Cushion-like masses of about 10 cm. diam. Composed of intricate diverging dichotomous jointed fronds. Joints terete, 3-5 mm. long, 1 mm. diam. Forks diverging at wide angles, 45° or more. Apices blunt, rounded-abciss. Gencula inconspicuous, calcified externally. Conceptacles round, flatly conical, borne laterally. Colour pink. Highly calcified.

Belongs to the Section Eu-Amphiroa of Decaisne. By its regular dichotomies separated from the other species of De Toni (*Syll.*, Vol. iv, Sect. 5, and Vol. vi, Sect. 5), as also from the Amphiroas of Yendo (Corall. Japon.) of Japan.

Complanata moles ad 10 cm. diam., frondibus intricatis divergentibus dichotomis articulatis contexta. Articuli teretes, 3-5 mm. longi, 1 mm. lati. Apices obtusi, rotundato-abcissi. Gencula inconspicua, crusta calcarea investita. Conceptacula lateralia depresso-conicalia. Color erubescens.

JANIA Lamouroux.

JANIA RUBENS L.

Common on the reef and rocks around the lagoon.

CORALLINA (Tournefort) Lamouroux.

CORALLINA CHILENSIS Dcne.

Densely caespitose, covering the surface of the reef in places in the neighbourhood of low-tide mark. About an inch high. Dull pink. Conceptacles small, ovate, terminal, without antennae.

Common on the ocean shores near Sydney. Recorded from Norfolk Island, Chile and Japan.

CORALLINA ROSEA Lamarck.

A most beautiful and graceful plumose species of a bright rose colour. Pinnules very numerous, slender, subcapillary, with joints thrice as long as the diameter. Conceptacles terminal, urceolate, with two long antennae of several joints. The characters agree well with Lamarck's description as given in De Toni, but the pinnules and antennae are longer than in Harvey's figure in *Nereis Australis*.

Our plants were cast up, probably from deeper water, caespitose, the separate fronds to 10 cm. high. Harvey's specimens were from King George's Sound, W.A.

The Red Algae are the most numerous in species, including, in fact, more forms than the Greens and Browns combined. The list shows Green 24, Brown 23, Red 53.

The stony *Goniolithon* and the massive *Lithothamnion* are tropical. The latter plays a prominent part in the building of the largest of the present-day live coral reefs.

In general, however, there is a mingling of forms, the Temperate Zone species being in the majority. Australian weeds are occasionally drifted across and the New Zealand *Euptilota formosissima* has once been picked up on the beach.

As in the other Groups, the Lord Howe isolation and environment have resulted in the development of peculiar forms. Zanardini described as new species *Mychodea halymenioides* and *M. fastigiata*, *Sarcodia ciliata*, *Martensia speciosa* and *Polysiphonia Gelidii*. To these in the present paper are added *Bangia* (?) *simplex*, *Liagora Howensis*, *Gelidium Maidenii*, *Sarcocladia* (?) *rhizophora*, *Gracilaria Howensis*, *Laurencia elegans*, *Polysiphonia Baxteri*, *Dasya fruticulosa*, *Ceramium Setchellii* and *Amphiroa Howensis*. Thus nearly one-third of the Red Algae are peculiar to the island.

ECOLOGY.

There are three well marked regions: (1) the lagoon, (2) the fringing reefs exposed at low tide, (3) the deeper waters outside the reefs. Our work was practically confined to (1) and (2).

The plants of the lagoon were *Ulva Lactuca*, *Cladophora Goweri*, *Spongocladia vaucheriiiformis*, *Acetabularia calyculus*, *Bryopsis comosa*, *Codium Lucasii*, *C. spongiosum*, *C. bulbopilum*, *Sargassum Howeanum*, *S. spinifex* and other *Sargassa*, *Hormosira Banksii*, *Gymnosorus nigrescens*, *Padina Pavonia*, *Haliseris crassinervis* and *H. plagiogramma*, *Glossophora Harveyi*, *Colpomenia sinuosa*, *Hydroclathrus cancellatus*, *Ectocarpus confervoides*, *Helminthocladia tumens*, *Pterocladia lucida*, *P. capillacea*, *Sarcodia ciliata*, *Plocamium hamatum*,

Asparagopsis taxiformis, *Laurencia majuscula*, *Dasya fruticulosa*, *Ceramium Setchellii*. The Browns were most abundant, often growing in groves, the Reds and Greens growing sporadically.

Characteristic of the Reefs were *Dictyosphaeria favulosa*, *Valonia Forbesii*, *V. pachynema*, *Cladophoropsis Howensis*, *Caulerpa taxifolia*, *C. thujoides*, *C. racemosa*, *C. peltata*, *Chlorodesmis major*, *Dictyota rugulosa*, *Helminthora tumens* (tall form), *Liagora Howensis*, *Galaxaura rudis*, *G. fastigiata*, *G. tumida*, *Sarcocladia* (?) *rhizophora*, *Martensia speciosa*, *Amansia glomerata*, *Enantiocladia Robinsonii*.

In the south the western reef is, in its outer border, submerged, except at the rare times of extraordinary low tides, and we were not able to reach it. Here is the *Lithothamnion* reef. Here also we suspect grow *Laurencia concinna*, *Pterocladia lucida*, *Sarcodia ciliata*, *Laurencia majuscula* and *Enantiocladia Robinsonii*, as we judged by the number of plants thrown up in rough weather on a small beach south of the reef.

Of the deeper sea forms we only obtained *Ecklonia radiata*, brought up on a fishhook, but were informed that *Macrocystis pyrifera* had been observed there in quantity.

PHYSICAL CONDITIONS.

Lord Howe Island lies in 31° 33' S. lat. and 159° 3' E. long. It is a tropical outlier. According to Hedley, it is the most southerly island possessing living coral reefs.

It lies 300 miles due E. of Port Macquarie and 450 m. NE. of Sydney, 500 miles W. of Norfolk Island and 750 NW. of New Zealand.

It is crescent-shaped, seven miles long, with an average breadth of one mile, and consists of three volcanic ridges, connected by lower undulating land formed by wind-borne coral sand, which has consolidated under percolation of rain and fresh water into a calcareous rock, with more than 90 per cent. of calcium carbonate in its composition.

The volcanic rocks occupy two-thirds of the island and form three elevated ridges; the southern massif forming roughly one-half of the island, with the giants Mt. Gower (2,840 ft.) and Mt. Lidgbird (2,804 ft.); a lower intermediate ridge, with Mt. Lookout (414 ft.); and a northern, with the conical Mt. Eliza and Mt. Malabar or North Peak (714 ft.).

The sea face of the northern and the southern ridges consists of precipitous cliffs, 600-700 feet high, or more in the south. On the east are three sandy beaches, Ned's, Middle and Blinkenthorpe, with fringing reefs on the coast between them. On the west, on the concave side of the crescent, is a lagoon about four miles long and averaging half a mile in breadth, protected by a fringing coral reef which forms the chord of the crescent. This reef stretches from North Bay to Mount Lidgbird and has five gaps in it, the widest of which serves as a channel for smaller craft; larger vessels are obliged to anchor outside. The lagoon has an average depth of less than a fathom at low tide, though there are one or two deeper holes in which the corals are alive; at high tide another six feet of water are added.

The geological structure shows that the island has never formed an integral part of Australia or of New Zealand. The origin seems to have been the eruption of a number of volcanic peaks in this section of the band of weakness which stretches round the West Pacific from the Kuriles to New Zealand. Some of

these, as the six Admiralty Islands only a quarter of a mile off, and Ball's Pyramid (1,816 ft.), a number of miles to the SE., have remained isolated, but the volcanic ridges of Lord Howe have become connected to form a larger island.

In periods of comparative rest, corals grew on the sides of the peaks forming fringing reefs; the debris of these formed the sandy beaches and was carried thence by the strong winds from east and west, to a height in places of 250 feet above sea-level. Thus the wind-blown sand accumulated and eventually filled in the channels between the several islets and, consolidating into rock, now forms the lower levels of the island. A depression of a comparatively few feet would reduce Lord Howe to its original condition of a group of small islets.

That the coral sand rock is of aeolian origin was pointed out by Etheridge, and is confirmed by the observations of Anderson, McCulloch and others. Thus Dr. Anderson writes: "This coral-sand rock consists of comminuted and completely rounded coral debris, with grains of volcanic material such as augite, magnetite, and altered lava, with occasional fragments of echinoderms, shells, foraminifera and other invertebrates. Speaking generally, the constituents of the coral-sand rock agree very closely with the component particles of the present beach at Lord Howe Island. It varies in thickness, its greatest elevation being about 250 feet above sea-level" (Dr. Charles Anderson, *Records of the Australian Museum*, Vol. xiv, No. 4).

The date or dates of the volcanic eruptions cannot be precisely specified. "These volcanic rocks", writes Sir Edgeworth David, "appear to belong to three leading types, (1) basalt with olivine, (2) basalt without olivine, lateritic, (3) basalt diabasic, probably of considerable geological antiquity. . . . A vast period of time must have elapsed between the eruption of (3) and (1). . . . All the basalts, with the exception of the diabasic types, are probably not earlier than Tertiary, and some may be Post-Tertiary. The diabasic basalt is probably Pre-Tertiary, and may be Palaeozoic."

The age of the coral-sand rock may be surmised from the organic remains preserved in it. These include shells of the large land shell *Placostylus*, commonly found in the rock, together with bones and eggs of the burrowing Mutton Bird (*Puffinus*), and scattered bones and four eggs of the large Chelonian *Meiolania platyceps*. The last is the only extinct form known from the rock. Dr. Anderson has given us two important memoirs on this reptile. He concludes that *Meiolania* was essentially a terrestrial reptile, in gait and posture very similar to *Testudo*. He has further described another species, *M. mackayi*, from Walpole Island, one hundred miles SE. from New Caledonia. He writes: "In my previous paper I pointed out that, as Walpole Island is of coral origin, and has apparently never been connected with any larger land mass, the occurrence there of *Meiolania mackayi*, a form very similar to *M. platyceps*, indicates that the animal was able to cross a considerable stretch of ocean. This possibility is not excluded by its adaptation for a terrestrial existence, for *Testudo* is a good swimmer, as Beebe has pointed out (Galapagos). But on the whole, the skeleton of *Meiolania*, the proportions of its limb bones, the structure of its phalanges, and its heavily armoured condition, strongly indicate that it was built for life on land" (*Records Australian Museum*, Vol. xvii, No. 7).

From the above I think we may conclude that the sand-rock formation may have commenced in the Pliocene, but has been chiefly built up in Pleistocene times, and that we may claim that the island has been isolated from the beginning of the Pleistocene, which gives ample time for the evolution of new forms of life.

SOURCES OF THE MARINE FLORA.

The origin of the Marine Flora must naturally be considered in conjunction with the origin of the other denizens of the island.

With regard to the land fauna, much research has been made. No indigenous mammalia have existed. Rats came ashore in 1919 from a stranded vessel and proved a pest. They have destroyed almost all the native birds, and are still present in hordes to the grave detriment of the palms and garden produce. The land birds were almost all peculiar to the island, showing, according to Basset Hull, closer relations with Australia than with New Zealand, while, according to Tom Iredale, the extinct Pigeon and the extinct Rail were definitely of New Caledonian association. Even among the sea birds, an endemic species of Mutton Bird (*Puffinus*) has been described, which breeds on the island. Of the three small indigenous lizards, the commonest is known from north-west Australia. A. M. Lea noted the affinity of the insects with those of northern New South Wales, but there is an admixture of forms which have reached New Zealand.

Of the land mollusca, Tom Iredale writes me as follows: "Land mollusca are comparatively numerous, and some of large size indicating a continental connection." [Unfortunately the rats have played havoc amongst them and, though dead shells exist in great numbers, living animals are very scarce.] "These indicate New Caledonia as the land from which they arrived, so much so that it is difficult to separate the *Placostylus* of Lord Howe from New Caledonian species. This form has somehow managed to reach New Zealand, and is the cause of most of the Neozelanean sympathy. All the other Lord Howe Island land shells are of New Caledonian affinity, most being very closely related."

The land vegetation is most luxuriant, and the Palms, Screw-Pine, Banyan and *Marattia* are eminently tropical. There is a large proportion of endemic species. The affinities are preponderantly Australian, according to Prof. Ralph Tate. The plants may be presumed to have come south by a course parallel to that of the great southern migration of the Indo-Malayan Flora along the east of Australia from Cape York to Croajingolong.

Of the marine fauna the mollusca are pre-eminently New Caledonian (Tom Iredale), and the crustacea (F. A. McNeill) and echinodermata (A. Livingstone) all show a northern origin, with some Australian affinities.

The Great Equatorial Current of the Pacific due to the SE. trade winds is bisected as it impinges on New Caledonia. The southern branch passes on to the coast of Australia, which it reaches in the neighbourhood of Sandy Island, and is then deflected south to flow parallel to coasts of Queensland and New South Wales as far as Jervis Bay. It is a warm, constant current with a width of at least 300 miles seaward. This current must have been the main agent in the dispersal of tropical organisms to the south.

In accord with the land plants and animals and the marine invertebrates, the marine algae have a distinctly tropical facies, as seen in the separate analyses of the Greens, Browns and Reds. The conclusion seems to be that during Pleistocene time the algae have streamed down from the north, from New Caledonia, along with *Meiolania*. Some of the Lord Howe algae, as *Plocamium hamatum*, *Laurencia concinna*, *Amansia glomerata* and *Enantiocladia Robinsonii*, have been found at Noosa Heads and Caloundra on the coast of Queensland, and quite recently I have received specimens of the last three from Point Archer on the Queensland coast, nine miles north of Cooktown. Such migration goes a long way to explain the Australian affinities of the Lord Howe forms. It seems to be

pretty clear that none of the forms came from New Zealand, but rather that some forms, as *Glossophora* and *Placostylus*, passed from the north on a continuation of the line of migration, and thus reached the North Island of New Zealand. Probably in this way the slenderer affinities of all the organisms with those of New Zealand may be best explained.

EXPLANATION OF PLATES V-IX.

Plate v.

- Fig. 1.—*Cladophora Goweri*, n. sp.
Fig. 2.—*Caulerpa thujoides* J. Ag.
Fig. 3.—*Codium bulbopilum* Setch.

Plate vi.

- Fig. 1.—*Codium cuneatum* Setch. & Gard.
Fig. 2.—*Sargassum Howeanum*, n. sp.

Plate vii.

- Fig. 1.—*Haliseris crassinervia* Zan.
Fig. 2.—*Haliseris plagiogramma* Mont.
Fig. 3.—*Gelidium Maidenii*, n. sp.

Plate viii.

- Fig. 1.—*Martensia speciosa* Zan.
Fig. 2.—*Laurencia elegans*, n. sp.

Plate ix.

- Fig. 1.—*Laurencia concinna* Mont.
Fig. 2.—*Dasya fruticulosa*, n. sp.
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